TP 3097

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# M.V. ARCTIC
# INSTRUMENTATION AND DATA COLLECTION SYSTEM

# FOR

# SHIP OPERATIONS IN ICE

**

## SYSTEM OPERATING AND USER'S MANUAL

## VOLUME II
## (HARDWARE MANUAL)

FENCO CONSULTANTS LTD.
in conjunction with
GERMAN & MILNE INC.

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**17. Abstract**

The report provides an updated description of an Instrumentation and Data Collection System installed in the motor vessel "Arctic". This system is designed to provide a record of the ship's operational experience when navigating in ice, both in terms of the prevailing environmental conditions and the ship's performance and response. Records of hull strains resulting from ice impacts, together with ship machinery parameters (such as shaft RPM, fuel rack settings, torque, thrust and propeller pitch) and ship speed, direction and motions are obtained with this system. A computer-controlled time-division-multiplex system is used to sample the analogue output of each sensor, convert to digital form, and record on magnetic tape. Recording can be started manually or set to start automatically when specified signals exceed preset threshold levels. This report contains complete user information for operating the system and for carrying out routing hardware maintenance and software changes.

Volume 1 - Provides a general description of the system with operating and calibrating instruction, and a discussion of sampling schemes.
Volume 2 - Provides a detailed description of the hardware components including the CCTV System, along with manufacturer's information.
Volume 3 - Provides an introduction to the Rolm 1603A Computer, with details of the data acquisition and playback programs.

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17. Résumé

Ce rapport constitue une description mise à jour de l'instrumentation et du système de saisie de données installés à bord du cargo brise-glace Arctic et destinés à relever le comportement du navire dans les glaces en enregistrant les conditions rencontrées de navigation et les caractéristiques correspondantes de manoeuvre. Les déformations de la coque sous l'impact des glaces et les paramètres du fonctionnement de la machinerie (révolutions de l'arbre en tr/min., réglage des injecteurs de carburant, couple moteur, poussée et pas d'hélice), ainsi que la vitesse, la direction et les mouvements du navire ont été relevés. Les signaux des jauges de contrainte, sortant en analogie, sont enregistrés par un ordinateur qui en compile l'échantillonnage et le multiplexage par répartition dans le temps, les convertit en numérique et les consigne sur bande magnétique. L'enregistrement peut être déclenché soit manuellement soit automatiquement et, dans ce dernier cas, dès que certains signaux dépassent un seuil fixé à l'avance. Ce rapport fournit aussi des instructions complètes aux usagers sur la mise en oeuvre du système en question, sur l'entretien normal du matériel et sur la manipulation des logiciels.

Volume 1 - Description générale du système de saisie de données, instructions sur la mise en oeuvre et l'étalonnage, et suggestions sur les modalités d'échantillonnage.

Volume 2 - Description détaillée des composants matériels, y compris la télévision en circuit fermé, et instructions du manufacturier.

Volume 3 - Description de l'ordinateur Rolm 1603A et instructions détaillées sur l'acquisition et la lecture des données.

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Comportement dans les glaces
Déglaçage
Navires de catégorie arctique
Coque

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# SYSTEM OPERATION AND USER'S MANUAL

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# SYSTEM OPERATION AND USER'S MANUAL

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# SYSTEM OPERATION AND USER'S MANUAL

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# PART I

# GENERAL DESCRIPTION

# LIST OF FIGURES

## Part I

| | |
|---|---|
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| Fig. 8 | " " " " |
| Fig. 9 | " " " " |
| Fig. 10 | " " " " |

## General Description

The purpose of the data acquisition system is to gather and record the necessary data to assess the performance of the ship when moving through ice. Provision is made to handle 255 channels with any one channel being sampled at a rate up to 1000 samples a second, and a total system sampling rate of 1765 samples a second. To handle this quantity of data, a time division multiplex system, controlled by a minicomputer, is used and each sample is digitised and recorded on tape.

The sensors (table 1) are mainly located in the forepeak, the engine room, or the bridge. Each sensor is connected to its own amplifier housed in a nearby subjunction box. The amplifier cards provide an analogue output of the parameter being measured. The amplifier cards are grouped in lots of 16: each lot (bin) has a master card which, on command from the computer, can switch the output of a particular amplifier card through onto a data bus where it is relayed back to the computer for processing and storage. The data bus forms a ring around the ship connecting all the bins in each subjunction box with the interface in the laboratory (fig 1).

The operation of the system is controlled by the computer which, following instructions, decides which sensors to address, when to address them, the processing required for the voltages received from each sensor, and whether to print the values obtained or record them on tape. The operation of the rest of the system can best be described by considering first the Address Route, and then the Data Route.

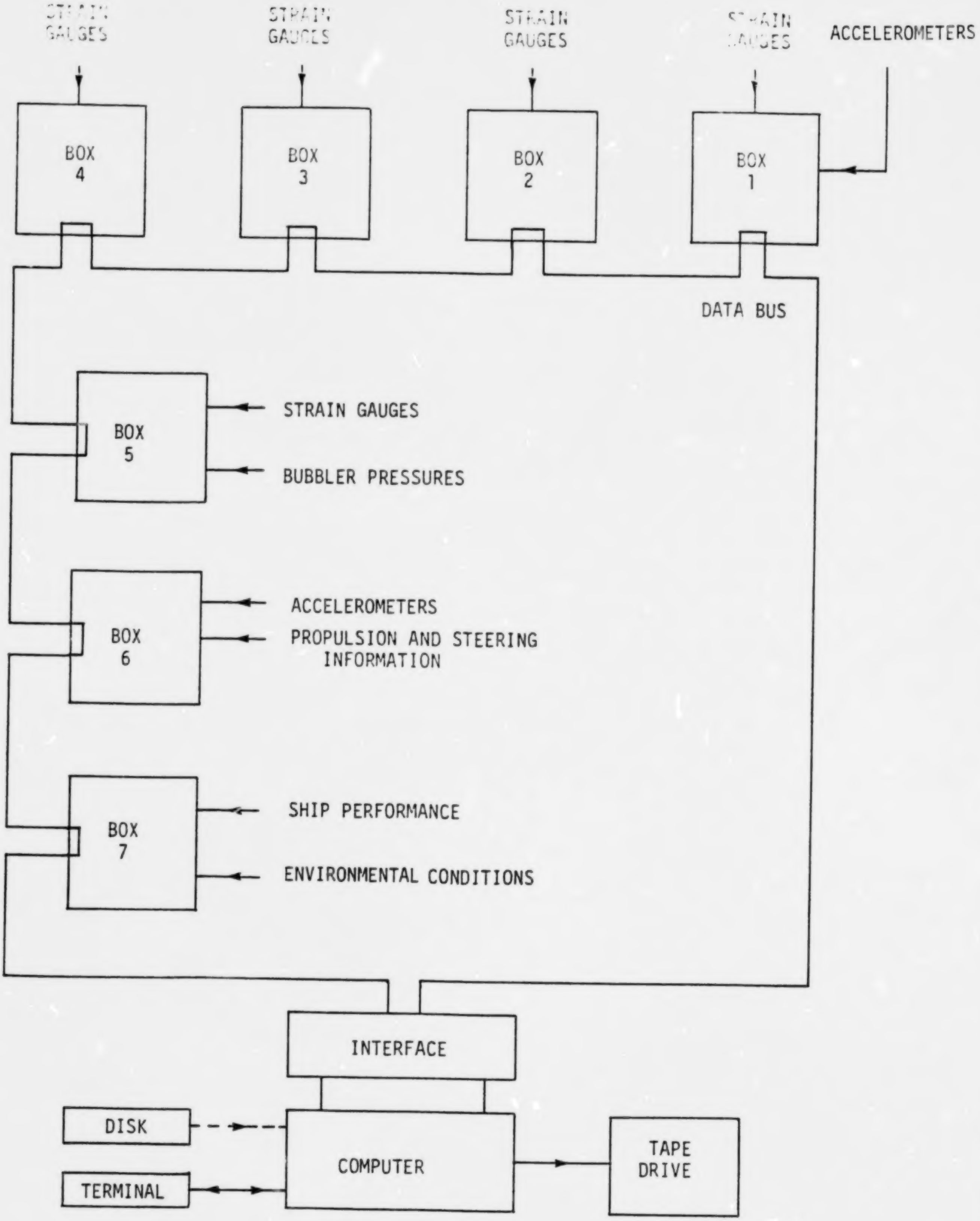

STRAIN GAUGES
STRAIN GAUGES
STRAIN GAUGES
STRAIN GAUGES
ACCELEROMETERS
BOX 4
BOX 3
BOX 2
BOX 1
DATA BUS
BOX 5
STRAIN GAUGES
BUBBLER PRESSURES
BOX 6
ACCELEROMETERS
PROPULSION AND STEERING INFORMATION
BOX 7
SHIP PERFORMANCE
ENVIRONMENTAL CONDITIONS
INTERFACE
DISK
TERMINAL
COMPUTER
TAPE DRIVE

FIGURE 1

DATA ACQUISITION SYSTEM

## Address Route

Sensors are addressed by bin and then by amplifier card within that bin. The master cards have switches to select the particular address code the master card will respond to. The card address is set by the wiring of the socket so that any amplifier card can be plugged into any socket. The addressing uses a binary code with one line for each bit: on the data bus 5 lines carry the bin address (1 spare for expansion) and 4 lines carry the card address, binary 0 corresponds to 0 Volts, binary 1 corresponds to +15 Volts.

When the computer samples a particular sensor: for example, channel 33 (Card 1 in Bin 2) the address code is passed to the interface which sets the bin address lines on the data bus at 0010 and the card address lines at 0001. These voltage levels on the bus will appear at the address inputs of every master card. However, only the master card in bin 2 is set to respond to this particular address code. The response of the master card is to set the 'card enable' line in that bin to 1. The master card also relays on the card address ABCD and generates the inverse of the card address ABCD. Of these 8 lines only 4 are connected to any one amplifier card socket so as to select the appropriate amplifier card (and sensor). In our example the card address ABCD is 0001 and so ABCD is 1110. Therefore, the card in the socket wired to ABCD will be the only one to receive an input of 1111 and respond to that address. With the card address received and a 'card enable' signal received from the master card, one of two switches is closed to send the amplifier output through to the master card and from there back to the computer. The choice of switch is decided by whether the 'Real' or 'Peak' amplifier output has been selected.

## Data Route

The majority of sensors used are resistive elements such that a change in the parameter being measured produces a change in the resistance of the sensor. The sensor is connected in a bridge circuit so that the change in sensor resistance produces a voltage change. This can then be amplified to produce a voltage output proportional to the magnitude of the parameter in question. The amplifier gain is chosen to give a 0 to +10V output for the desired range x of each parameter x. Where the variable x goes from -x to +x (eg. strain gauges) the amplifier reference voltage is set to +5V so that a signal -x changes the amplifier output to 0V and +x changes it to +10V. For variables that only go positive (eg. visibility), the reference voltage is set at 0V so for x=0 the amplifier output is 0V, and for x=x the amplifier output is +10V. From the sensor to the amplifier output, (available on the 'Real'test point) the system is purely analogue and operates independently of the computer.

When the 'card address' and 'card enable' signals are received by the selected amplifier card, the amplifier output is switched through to the master card. At the master card the 0 to +10V is sent along two different paths: one goes straight through while the other goes through an inverter to produce a 'mirror-image' of the signal. The same 'card enable' signal used for the amplifier card also switches these 'normal' and 'inverted' signals through to the driver circuits for Bus Y and Bus Z respectively. A +5V signal into the M/C produces +5V on both bus Y and bus Z and a difference voltage of 0V. A 0V signal-in gives bus Y=0V, bus Z=+10V, and a difference voltage (Y-Z)= -10V; correspondingly a +10V signal-in gives bus Y=+10V, bus Z=0V, and a difference voltage =+10V. An A/D converter in the interface produces a number, Ival, proportional to this difference voltage, Vdiff, and relays this number to the computer. Ival = 51.2.Vdiff + 512.

## Amplifier Card

The same basic circuit is used for all the amplifier cards with a few modifications being made to suit requirements on different channels. The circuit has been modified several times after the original circuit printing was done so that on some boards there are a few obsolete components and a few extra ones strapped in. Most of these modifications were tidied up in a later printing of more circuit boards.

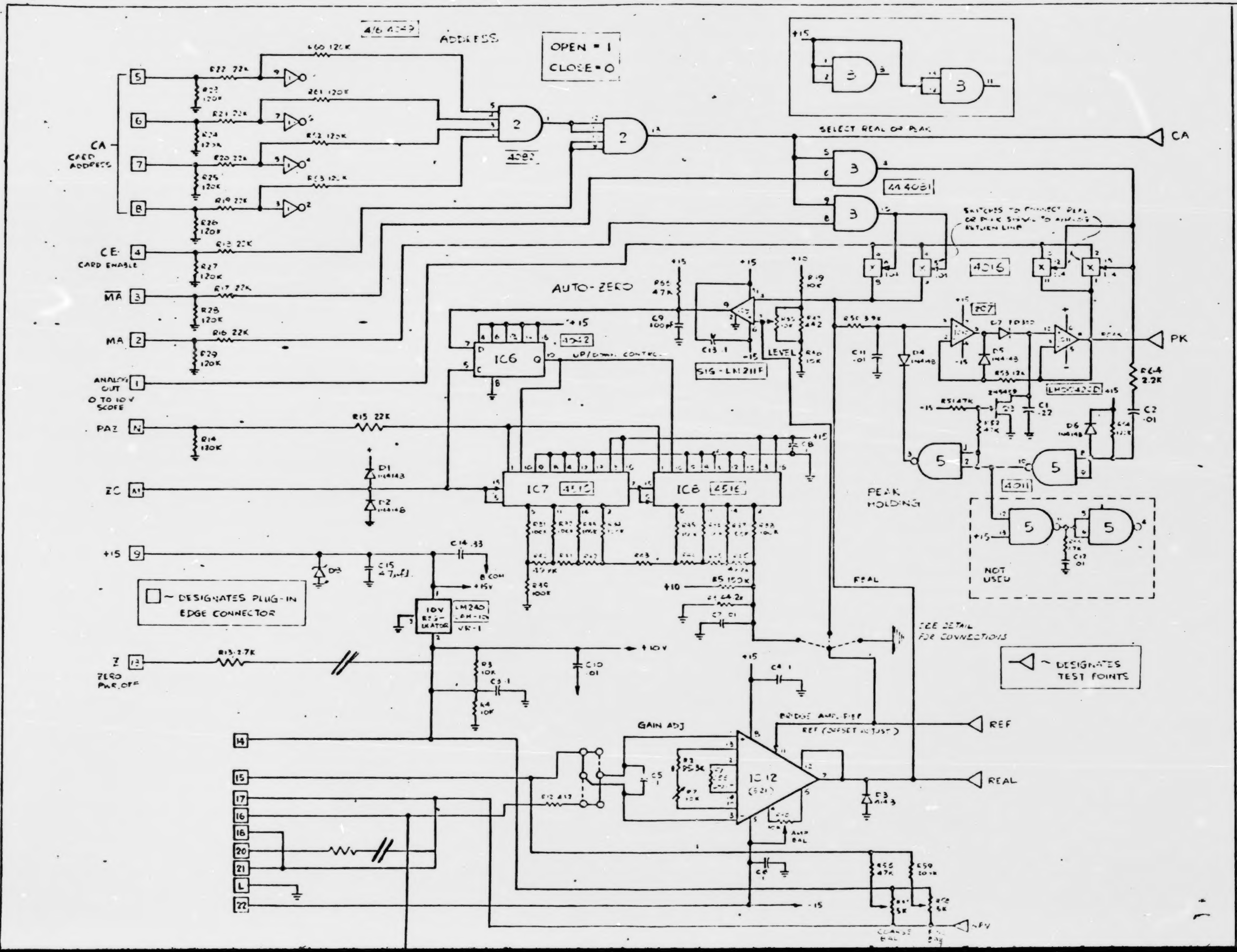
## Circuit Operation

The address and command lines come in on pins 2 to 8, and are connected through 120k resistors to ground to prevent the lines floating high when there is no signal (fig. 2). IC1 is obsolete and the address lines now go direct to an AND gate, IC2. The output of this gate goes high when the card is addressed; and when the card enable (CE) signal is received, the output of the 2nd AND gate (also IC2) goes high. This can be checked on test point CA. The signal from IC2 switches on one of the gates in IC3 which in turn operates one set of analogue switches (IC4) to switch through either a Real or Peak output to the analogue out, pin 1.

Sensors are connected to pins 14, 15, 16, 17. Pin 14 is at +10V with respect to system ground (A COM) and pin 17 through pin 21 (B COM) is connected to system ground in the wiring of the subjunction boxes. Thus, there is +10V across pins 14 and 17 for use with bridge type sensors. Pins 15 and 16 are connected to the amplifier IC12 and can be left floating for differential inputs, or pin 15 is strapped to pin 17 (ie. grounded) for positive-going inputs. The amplifier reference voltage can be connected to ground, for positive-going inputs; or connected to +5V or the 'auto-zero' reference, for differential inputs. The amplifier gain is determined by the value of R1, and adjustments can be made using the potentiometer R7. Potentiometer R8 controls the amplifier balance while potentiometers R7 and R8 are for the balancing of 'bridge' inputs. R7 and R8 have no effect when pins 15 and 17 are strapped together.

IC6, 7, 8 and 9 comprise the 'auto-zero' circuit which, on command, adjusts the 'auto-zero' reference voltage for the amplifier, to give an amplifier output of +5V corresponding to zero signal in. A signal on pin N (applied by pushing 'Preset Auto Zero' on the master card) sets the registers IC7 and 8 to their preset value and by doing so gives a reference voltage of +5.2V. When set for "Auto'Zero" the interface sends a pulse once a minute to the CLR input of the master card. This enables an oscillator (IC6 on M/C) which goes out on connection ZC to the amplifier cards. The ZC signals clocks the counters IC7 and 8 up or down depending on the output of IC6 which is controlled by the comparator IC9. The resistors connected to IC7 and 8 constitute a D/A converter so that changing the number in the register changes the reference voltage of the amplifier. The comparator adjusts this reference voltage until the amplifier output matches the voltage set by the LEVEL potentiometer.

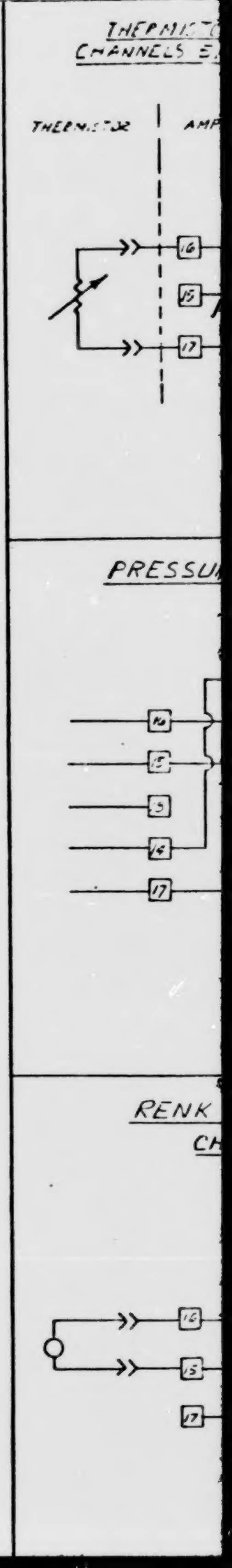
The peak detector circuit, comprising IC5, 10 and 11, holds the maximum positive value reached by the amplifier output during each sampling interval. IC10 is a comparator connected to unity gain amplifier IC11. The feedback loop R53 ensures fast charging of memory capacitor C1 by any positive signal, and D7 prevents C1 discharging. A positive pulse from IC3 switches on the analogue switches and connects the peak output to the analogue out line. The same pulse also goes to the differentiating network R64, C2, R54 to reset the peak detector. The trailing edge of the pulse generates a 1 millisecond negative going pulse at the input of the inverter (IC5). The high output of the inverter switches on FET Q3 allowing fast discharge of the memory capacitor C1. At the same time the second inverter (also IC5) output goes low so holding the peak detector input to 0V through D4. At the end of 1 millisecond, the peak detector is enabled again.


4/6 4049
ADDRESS
OPEN = 1
CLOSE = 0
CA
CARD ADDRESS
5
6
7
8
R22 22K
R21 22K
R20 22K
R19 22K
R23 120K
R24 120K
R25 120K
R26 120K
R60 120K
R61 120K
R62 120K
R63 120K
2
4082
CE
CARD ENABLE
4
R18 22K
R27 120K
MA
3
R17 22K
R28 120K
MA
2
R16 22K
R29 120K
ANALOG OUT
0 TO 10 V SCOPE
1
PAZ
N
R15 22K
R14 120K
ZC
D1 1N4148
D2 1N4148
+15
9
C15 4.7µf
C14 .33
B COM
+15V
D3
~ DESIGNATES PLUG-IN EDGE CONNECTOR
10V REGULATOR
LM240 LAH-10
VR-1
Z
ZERO PWR.OFF
13
R13 2.7K
+10V
R3 10K
R4 10K
C3 .1
C10 .01
14
15
17
16
18
20
21
L
22
+15
3
SELECT REAL OR PEAK
CA
4A 4081
SWITCHES TO CONNECT REAL OR PEAK SIGNAL TO ANALOG RETURN LINE
4016
AUTO-ZERO
R55 47K
C9 100pf
C13 .1
SIG - LM211F
LEVEL
R40 10K
R9 10K
IC6
4042
UP/DOWN CONTROL
+15
IC7
4516
IC8
4516
C8
R50 3.9K
C11 .01
D4 1N4148
IC7
D7 FD300
D5 1N4148
R53 12K
LH0042CD
R51 47K
R52 47K
C1 .22
D6 1N4148
R64 2.2K
C2 .01
PK
PEAK
5
4011
PEAK HOLDING
NOT USED
C17 .01
R45 150K
+10
C7 .01
REAL
SEE DETAIL FOR CONNECTIONS
~ DESIGNATES TEST POINTS
+15
C4 .1
GAIN ADJ
BRIDGE AMP. REF
REF (OFFSET ADJUST)
REF
C5 .1
IC 12
R12 412
D3
REAL
AMP BAL
C6
R56 47K
R59 10K
-15
COARSE BAL
FINE BAL
5K

## GAIN RESISTOR VALUES - R1

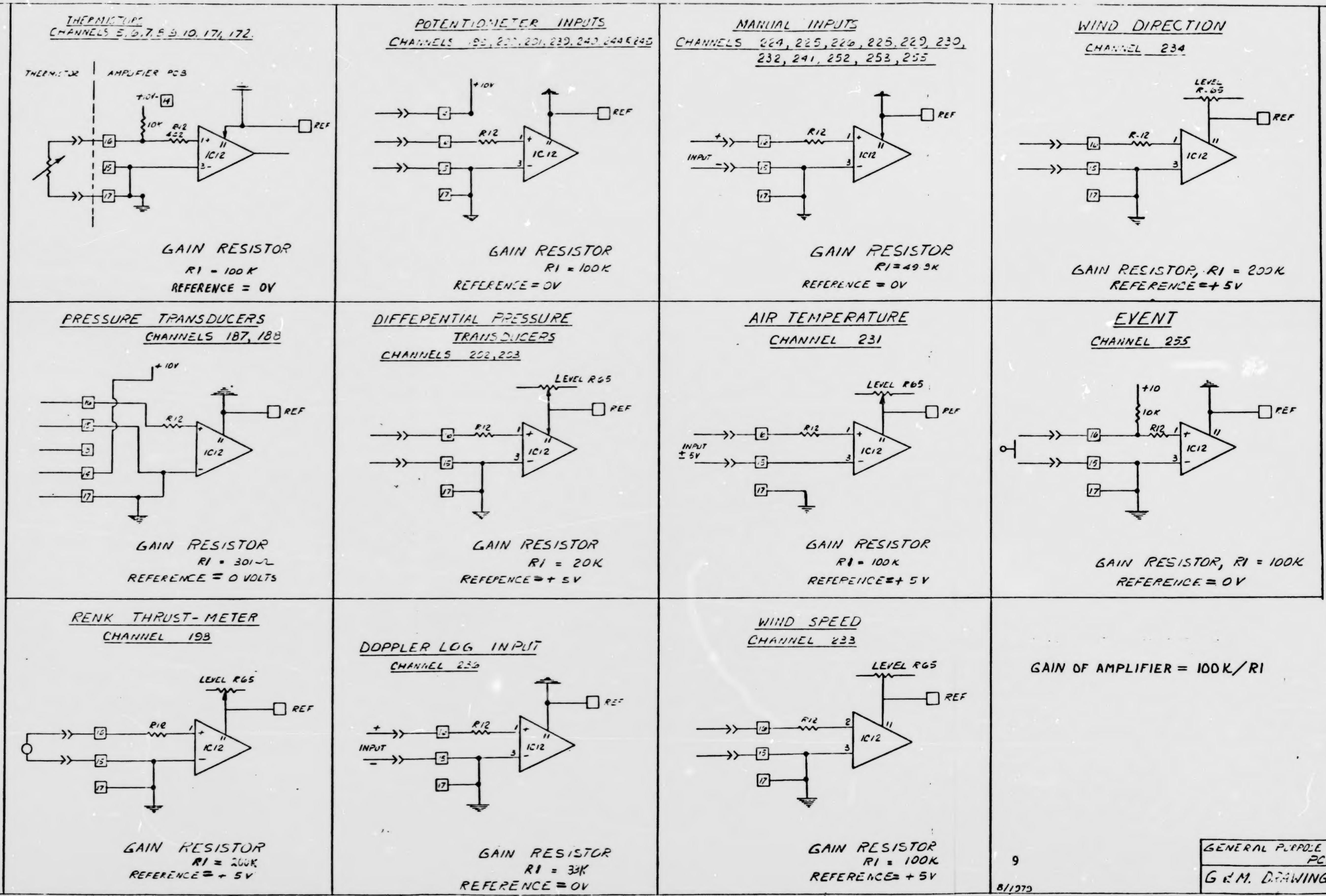
(ALL RESISTORS 1%)

| | | |
|---|---|---|
| CHANNEL - 1 - | 216 Ω | - INPUT |
| CHANNEL - 2 - | 301 Ω | |
| CHANNEL - 5-10 - | 100 K | |
| CHANNEL - 31 - | 525 Ω | |
| CHANNEL - 171-172 - | 100 K | |
| CHANNEL - 187-183 - | 301 Ω | |
| CHANNEL - 196 - | 40-2 K | |
| CHANNEL - 199 - | 100 K | |
| CHANNEL - 200 - | 100 K | |
| CHANNEL - 201 - | 100 K | |
| CHANNEL - 202 - | 10 K | |
| CHANNEL - 203 - | 10 K | |
| CHANNEL - 204-206 | 100 K | |
| CHANNEL - 208 - | 50 K | |
| CHANNEL - 212 - | 576 Ω | |
| CHANNEL - 213 - | 523 Ω | |
| CHANNEL - 214 - | 576 Ω | |
| CHANNEL - 224 - | 50 K | |
| CHANNEL - 225 - | 50 K | |
| CHANNEL - 226 - | 50 K | |
| CHANNEL - 228 - | 50 K | |
| CHANNEL - 229 - | 50 K | |
| CHANNEL - 230 - | 50 K | |
| CHANNEL - 231 - | 50 K | |
| CHANNEL - 232 - | 50 K | |
| CHANNEL - 233 - | 100 K | |
| CHANNEL - 234 - | 50 K | |
| CHANNEL - 236 - | 33 K | |
| CHANNEL - 237-245 | 100 K | |
| CHANNEL - 252-253 | 100 K | |
| CHANNEL - 255 | 100 K | |


THERMIS
CHANNELS
THERMISTOR
AMP
16
15
17
PRESSU
RENK
CH
16
15
17

STOR VALUES - R1
ESISTORS 1%)

316 Ω - INPUT
301 Ω
100 K
525 Ω
- 100 K
3- 301 Ω
40-2 K
100 K
100 K
100 K
10 K
10 K
6 100 K
50 K
576 Ω
523 Ω
576 Ω
50 K
50 K
50 K
50 K
50 K
50 K
50 K
50 K
100 K
50 K
33 K
100 K
3 100 K
100 K



THERMISTORS
CHANNELS 5, 6, 7, 8, 9, 10, 171, 172.

GAIN RESISTOR
R1 = 100 K
REFERENCE = 0V

POTENTIOMETER INPUTS
CHANNELS 199, 200, 201, 239, 240, 244 & 245

GAIN RESISTOR
R1 = 100K
REFERENCE = 0V

MANUAL INPUTS
CHANNELS 224, 225, 226, 228, 229, 230, 232, 241, 252, 253, 255

GAIN RESISTOR
R1 = 49.9K
REFERENCE = 0V

WIND DIRECTION
CHANNEL 234

GAIN RESISTOR, R1 = 200K
REFERENCE = + 5V

PRESSURE TRANSDUCERS
CHANNELS 187, 188

GAIN RESISTOR
R1 = 301 Ω
REFERENCE = 0 VOLTS

DIFFERENTIAL PRESSURE TRANSDUCERS
CHANNELS 202, 203

GAIN RESISTOR
R1 = 20K
REFERENCE = + 5V

AIR TEMPERATURE
CHANNEL 231

GAIN RESISTOR
R1 = 100K
REFERENCE = + 5V

EVENT
CHANNEL 255

GAIN RESISTOR, R1 = 100K
REFERENCE = 0V

RENK THRUST-METER
CHANNEL 198

GAIN RESISTOR
R1 = 200K
REFERENCE = + 5V

DOPPLER LOG INPUT
CHANNEL 236

GAIN RESISTOR
R1 = 33K
REFERENCE = 0V

WIND SPEED
CHANNEL 233

GAIN RESISTOR
R1 = 100K
REFERENCE = + 5V

GAIN OF AMPLIFIER = 100K/R1

8/1979

**FIGURE 2**

GENERAL PURPOSE AMPLIFIER
PCB. 7803C
G & M. DRAWING No. 3501-209

## Modifications

The amplifier cards were specifically designed for use with strain gauges; ie. with the auto-zero reference voltage used, and the amplifier set for a differential input. For use with other sensors, modifications have been made. The auto-zero reference must be disconnected by breaking the print connection at point A (see fig. 3a). To select a 0V or +5V reference voltage, a jumper lead is connected from the REF test point to the green CAL test point or the middle connection of the LEVEL potentiometer (point B on fig. 3b). For positive going signals join together the point connections from pins 15 and 17 at point C (fig. 3b).

Other changes are made for specific sensors, which are explained in the section for that sensor.

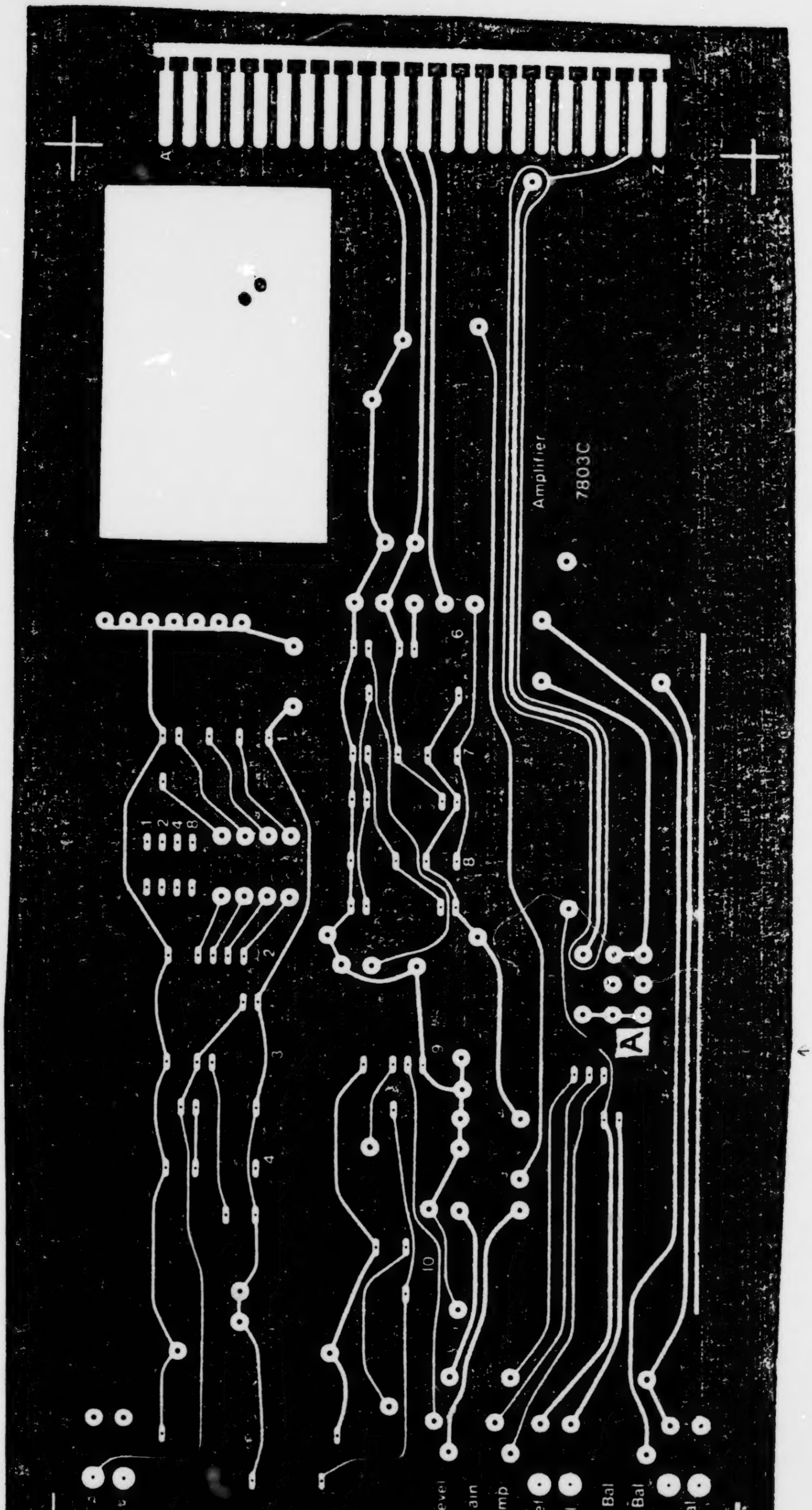

A
Z
Amplifier
7803C
1
2
4
8
1
2
3
4
6
7
8
9
10
A
Level
Gain
Amp
Ref
RI
C Bal
F Bal
Cal

FIGURE 3a

AMPLIFIER CARD MODIFICATION

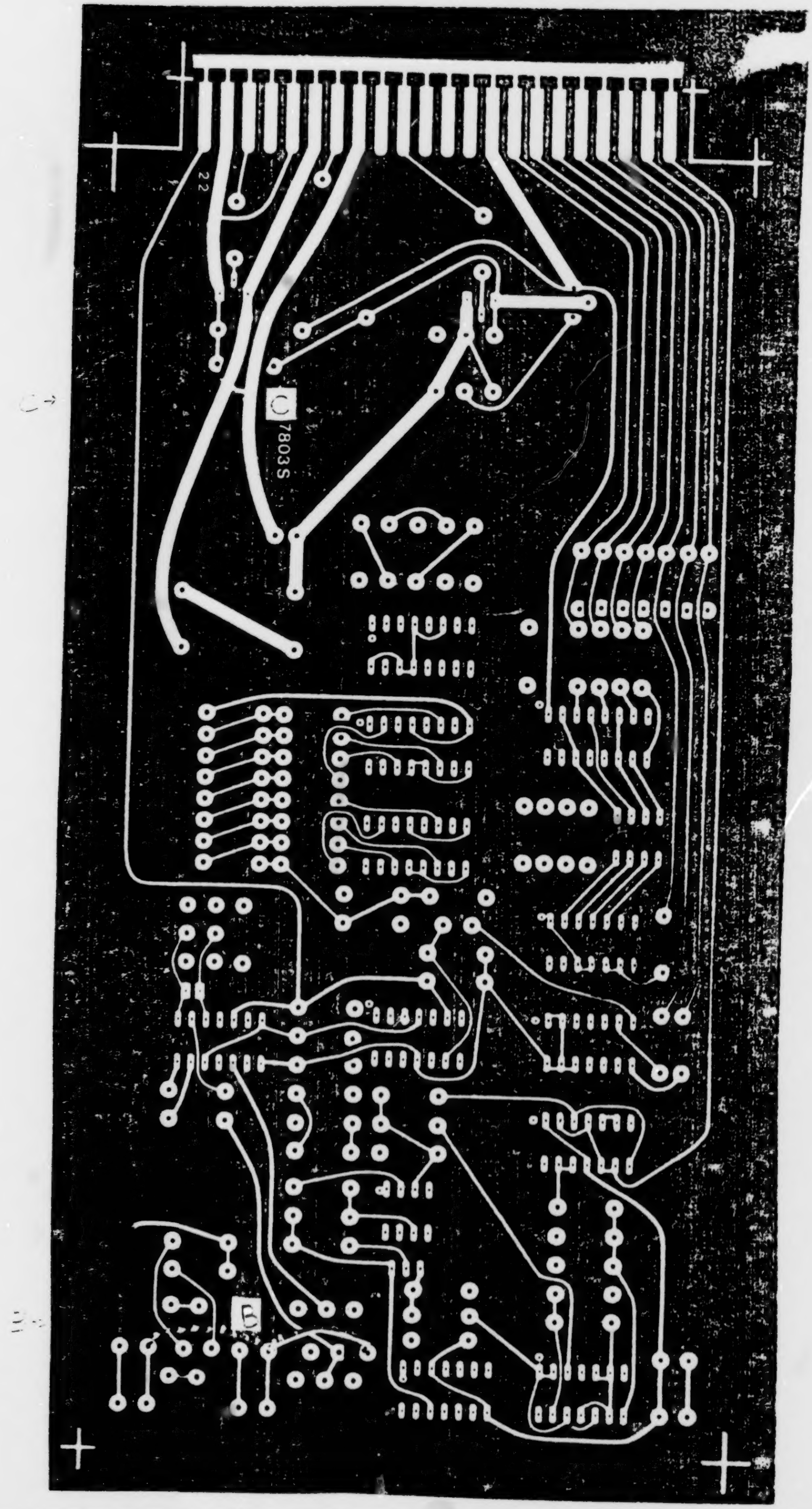

22
C
7803S
B
C→
B→

FIGURE 3b

AMPLIFIER CARD
MODIFICATION

## Filter Cards

To overcome aliasing problems some special cards were built with a low pass filter and an amplifier gain of 1. The filter cards are presently used with certain strain gauge channels and with the accelerometers, but could potentially be set to any corner frequency and used on any channel. The filter cards are modified amplifier cards: they can be addressed in the same way but all connections to pins 14, 15, 16 and 17 have been broken and the input now comes from a wander lead which can be plugged into the REAL test point of any selected amplifier card. (Figs. 5a and 5b)

Selecting the 'real' or 'peak' output from an amplifier card effectively involves switching through the signal from output A (real) or output B (peak). On the filter cards output A gives the signal from a low pass filter with corner frequency f; while output B gives the signal from a low pass filter with corner frequency f. There is no 'peak detecting' option on the filter cards. Selecting the 'peak' output simply means selecting output B: the output of a particular filter.

The circuit for the filter cards is shown in fig. 4. One filter comprises an RC network on the input of IC12. R12 and C5 are changed to give the required corner frequency, and the amplifier is set for a gain of 1 and reference voltage of 0V. The other filter uses the amplifier IC11, capacitor C1, and an added resistor. Q3, D7, D4, R50 are all removed to leave the circuit as shown.

The frequency characteristics of the filters used in a particular case are included in the appropriate section.

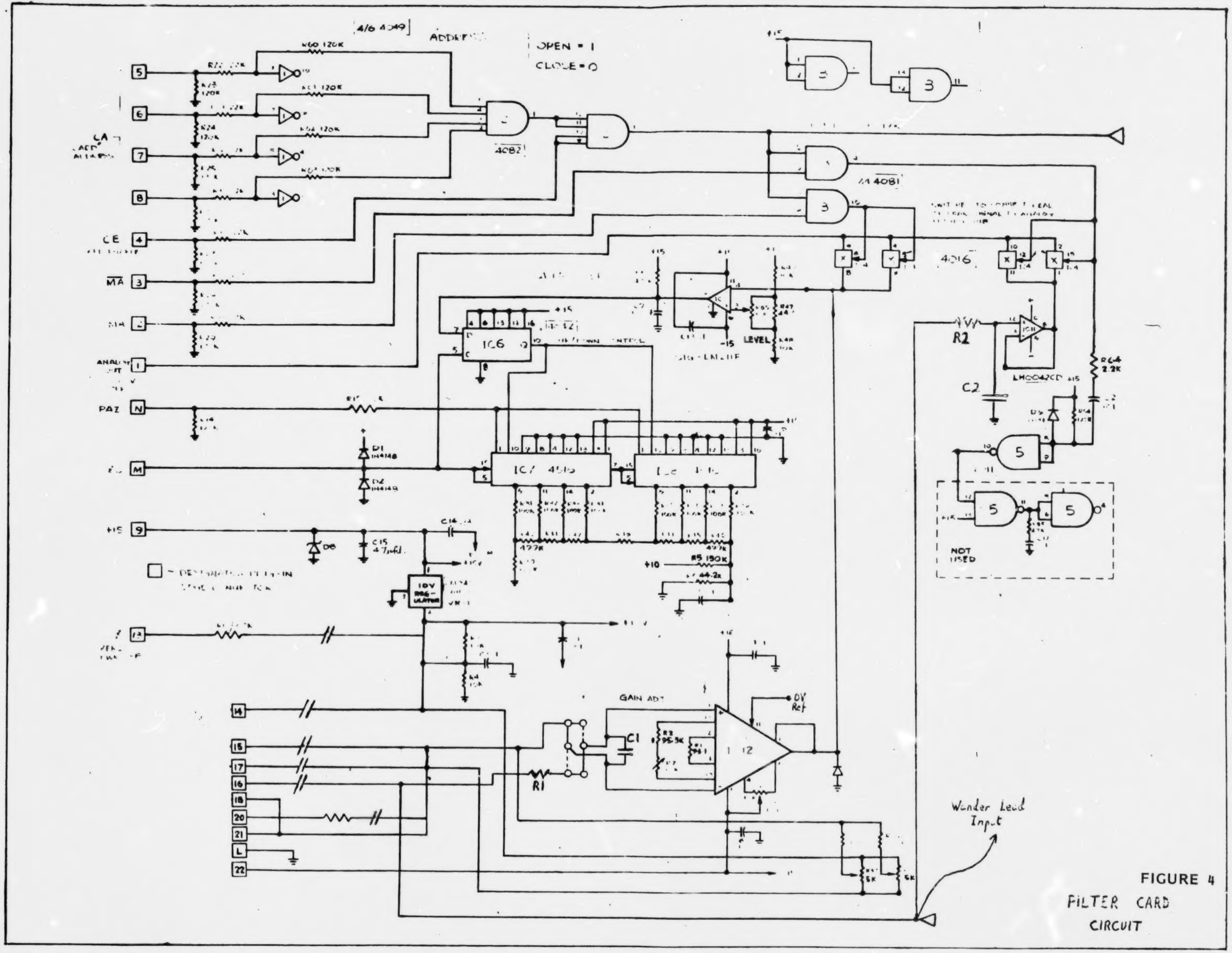

4/6 4049
ADDRESS
OPEN = 1
CLOSE = 0
CA
5
6
7
8
CE
4
MA
3
MA
2
ANALOG OUT
1
PAZ
N
M
+15
9
14
15
17
16
18
20
21
L
22
R60 120K
4082
4081
4016
IC6
IC7 4516
LEVEL
R47
D1 1N4148
D2 1N4148
C15 4.7μfd
10V REGULATOR
+10
R5 150K
422K
499K
GAIN ADJ
C1
R1
0V Ref
5K
5K
R2
C2
LH0042CD
R64 2.2K
3
5
5
5
NOT USED
Wander Lead Input

FIGURE 4

FILTER CARD CIRCUIT

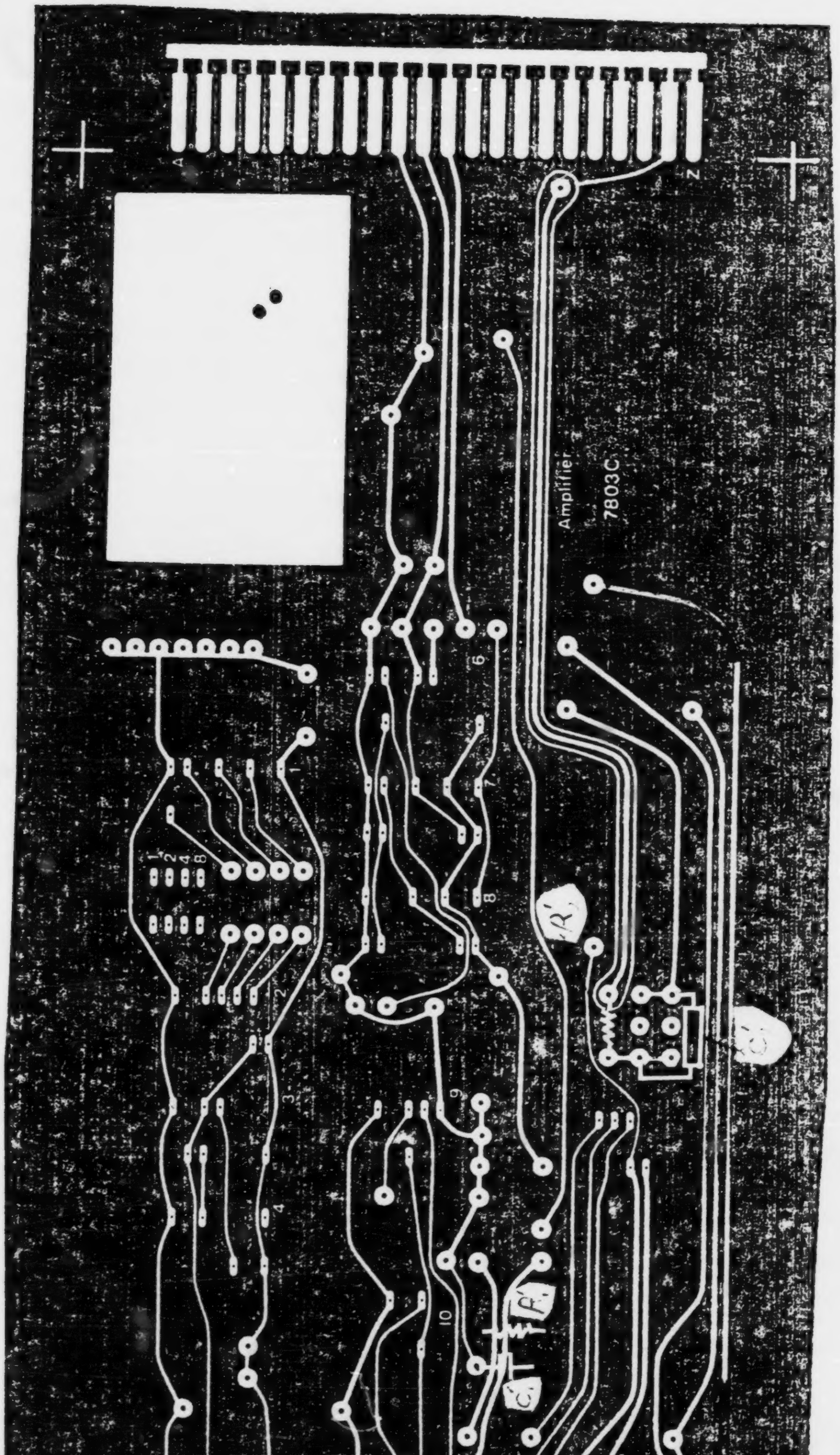

A
Z
Amplifier
7803C
1
2
3
4
6
7
8
9
10
1
2
4
8
Level
Gain
Amp
Ref
RI
C Bal
F Bal
Cal
R1
C1
R1
C1

FIGURE 5a

FILTER CARD
MODIFICATION

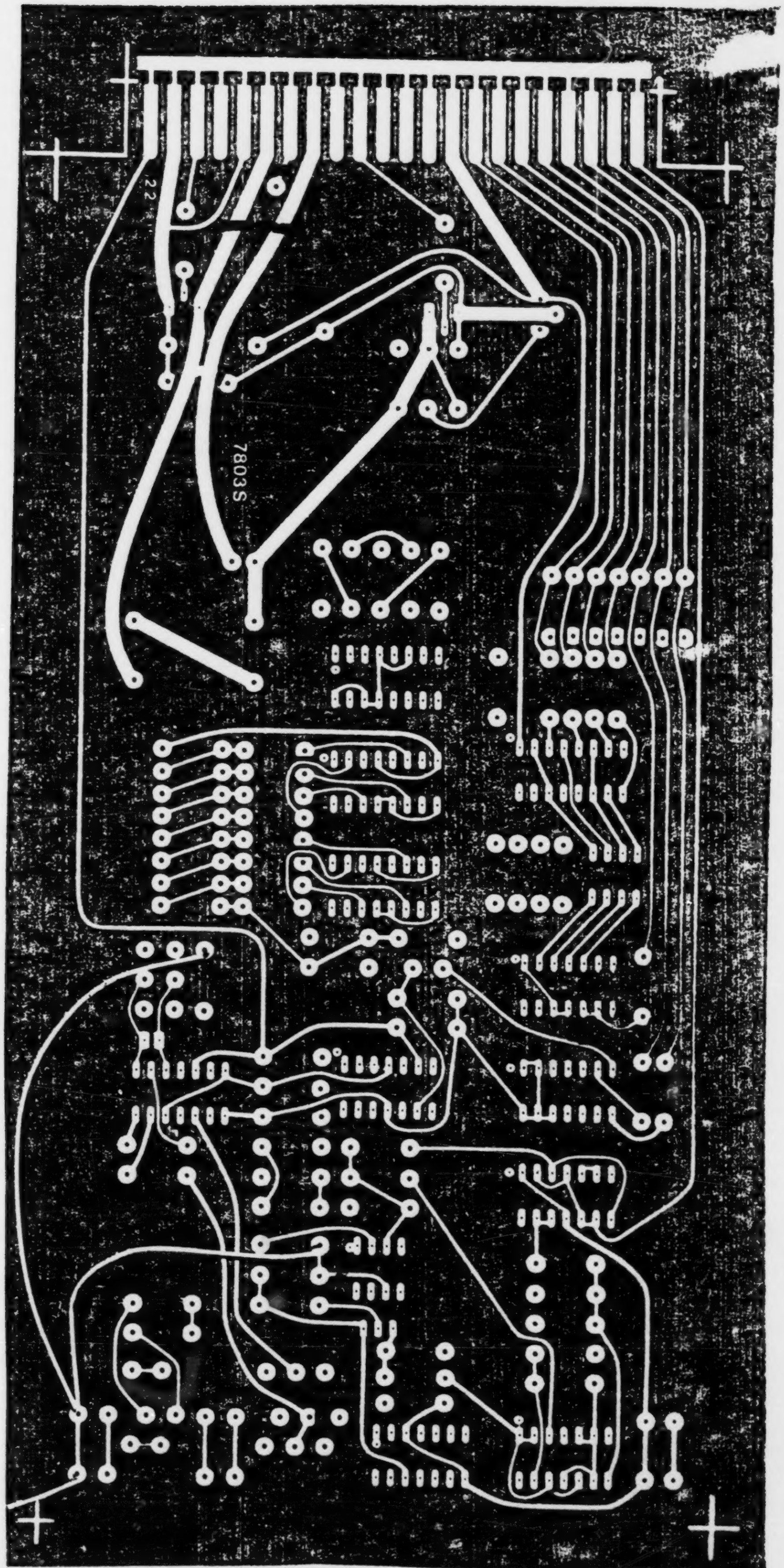


FIGURE 5b

FILTER CARD
MODIFICATION

Wander Lead
(Input) <

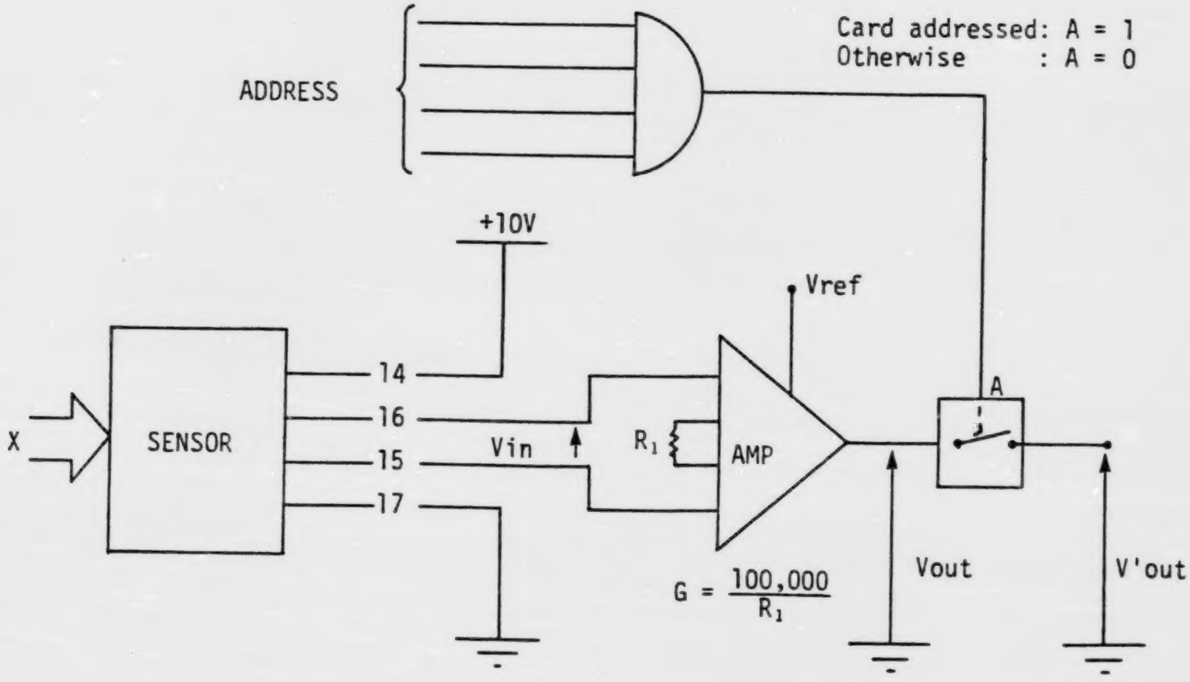
## System Characteristics

The parameters that are different for each sensor are:

1) the address, A
2) sensor sensitivity, S
3) Amplifier Gain, G
4) Amplifier reference voltage, Vref

and these must be confirmed or established for every channel. The rest of the system parameters are common to every channel, so once tested for one channel can be assumed correct for all.

The basic circuit is shown below. (Figure 6)


Card addressed: A = 1
Otherwise : A = 0
ADDRESS
+10V
Vref
A
X
SENSOR
14
16
15
17
Vin
R₁
AMP
G = 100,000 / R₁
Vout
V'out

Vin = S.X      Vout = G.Vin + Vref      V'out = A.Vout

FIGURE 6

BASIC CIRCUIT

## Notes for using the following tables

A line drawn through the sensor and amplifier characteristics indicates that the sensor is not functioning and no use will be made of that channel.

In the 'Remarks' column an O denotes the strain gauge conected was part of the original installation. An R denotes the strain gauges were installed when repairs were made to the bow of the ship. 'Hamburg' denotes strain gauges installed in Hamburg.

The column adjacent to 'sensitivity' contains an M or V. M indicates the sensitivity was obtained from manufacturer's specification. ✓ indicates the sensitivity was actually measured on board.

For strain gauges the value in the sensitivity column is the gauge factor.

Under 'Gain' and 'Vref' the required values are listed and a ✓ in the adjacent column indicates the circuit has been checked and found to be set at these values.

## M.V. ARCTIC DATA ACQUISITION SYSTEM

## DESIGN SYSTEM CHARACTERISTICS

(FOR CURRENT STATUS OF SENSORS REFER TO MOST RECENT REPORT)

|  | BIN NO. | CH. NO. | CARD NO. | ADD. OKAY | SENSOR |  |  |  | AMPLIFIER CARD |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | REF. NO. | TYPE | SENSITIVITY |  | GAIN |  | V REF. |  | RANGE | REMARKS |
|  | 0 | 1 | 1 | ✓ | Heave | ACC | 6.4 mV/g | M |  |  | 5 | ✓ | ±2.5g | 0 |
|  | 0 | 2 | 2 | ✓ | Sway | ACC | 6.5 mV/g | M |  |  | 10 | ✓ | ±2.5g | 0 |
|  | 0 | 3 | 3 |  | 2005-88 | S/G | 1.96 | M |  |  |  |  |  |  |
|  | 0 | 4 | 4 |  | 2015-89 | S/G | 1.96 | M |  |  |  |  |  |  |
| H | 0 | 5 | 5 | ✓ | Temp. | Therm. |  |  | 1.0 | ✓ | 5 | ✓ | ±50°C |  |
| H | 0 | 6 | 6 | ✓ | of Hull | Therm. |  |  | 1.0 | ✓ | 5 | ✓ | ±50°C |  |
| H | 0 | 7 | 7 | ✓ | Temp. | Therm. |  |  | 1.0 | ✓ | 5 | ✓ | ±50°C |  |
| H | 0 | 8 | 8 | ✓ | of Hull | Therm. |  |  | 1.0 | ✓ | 5 | ✓ | ±50°C |  |
|  | 0 | 9 | 9 |  |  | Therm. |  |  |  |  |  |  |  |  |
|  | 0 | 10 | 10 |  |  | Therm. |  |  |  |  |  |  |  |  |
|  | 0 | 11 | 11 |  | 1790-100 | S/G | 1.90 | M |  |  |  |  |  | R |
|  | 0 | 12 | 12 |  | 1790-101 | S/G | 1.90 | M |  |  |  |  |  | 0 |
|  | 0 | 13 | 13 |  | 1790-171 | S/G | 1.90 | M |  |  |  |  |  | 0 |
|  | 0 | 14 | 14 |  | 1810-102 | S/G | 1.90 | M |  |  |  |  |  | 0 |
| H | 0 | 15 | 15 |  | 1810-172 | S/G | 1.95 | M |  |  |  |  |  | R |
|  | 1 | 16 | 0 |  | 1810-173 | S/G | 1.90 | M |  |  |  |  |  | 0 |
| H | 1 | 17 | 1 | ✓ | 1830-174 | S/G | 1.90 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
|  | 1 | 18 | 2 |  | 1830-103 | S/G | 1.95 | M |  |  |  |  |  | 0 |
| H | 1 | 19 | 3 | ✓ | 1850-104 | S/G | 1.90 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 1 | 20 | 4 | ✓ | 1850-175 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 1 | 21 | 5 | ✓ | 1870-105 | S/G | 1.90 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
|  | 1 | 22 | 6 |  | 1870-176 | S/G | 1.90 | M |  |  |  |  |  | 0 |
|  | 1 | 23 | 7 | ✓ | 1890-106 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ |  | 0 |
|  | 1 | 24 | 8 |  | 1890-177 | S/G | 1.95 | M |  |  |  |  |  | 0 |
|  | 1 | 25 | 9 |  | 1910-178 | S/G | 1.95 | M |  |  |  |  |  | 0 |
| H | 1 | 26 | 10 | ✓ | 1910-107 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
|  | 1 | 27 | 11 |  | 1930-179 | S/G | 1.95 | M |  |  |  |  |  | 0 |
|  | 1 | 28 | 12 |  | 1945-108 | S/G | 1.95 | M |  |  |  |  |  | 0 |
| H | 1 | 29 | 13 | ✓ | 1950-109 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ |  | 0 |
|  | 1 | 30 | 14 |  | 1970-180 | S/G | 1.95 | M |  |  |  |  |  | 0 |
|  | 1 | 31 | 15 | ✓ | Surge | ACC | 10.6 mV/g | M |  |  | 5 | ✓ | ±2.5g |  |
| H | 2 | 32 | 0 | ✓ | 1890-149 | S/G | 1.90 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 2 | 33 | 1 | ✓ | 1890-150 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 2 | 34 | 2 | ✓ | 1895-92 | S/G | 1.77 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| H | 2 | 35 | 3 | ✓ | 1905-57 | S/G | 1.77 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| H | 2 | 36 | 4 | ✓ | 1910-58 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| H | 2 | 37 | 5 | ✓ | 1910-59 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| '' | 2 | 38 | 6 | ✓ | 1910-60 | S/G | 1.90 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
|  | 2 | 39 | 7 | ✓ | 1910-61 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
|  | 2 | 40 | 8 | ✓ | 1910-62 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |

M.V. ARCTIC DATA ACQUISITION SYSTEM

DESIGN SYSTEM CHARACTERISTICS

(FOR CURRENT STATUS OF SENSORS REFER TO MOST RECENT REPORT)

|  | BIN NO. | CH. NO. | CARD NO. | ADD. OKAY | SENSOR |  |  |  | AMPLIFIER CARD |  |  |  | RANGE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | REF. NO. | TYPE | SENSITIVITY |  | GAIN |  | V REF. |  |  |  |
| H | 2 | 41 | 9 | ✓ | 1910-90 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 2 | 42 | 10 | ✓ | 1910-91 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 2 | 43 | 11 | ✓ | 1919-151 | S/G | 1.77 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 2 | 44 | 12 |  | 1910-152 | S/G | 1.83 | M |  | ✓ | 5 | ✓ |  | Hamburg |
| H | 2 | 45 | 13 | ✓ | 1910-161 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 2 | 46 | 14 | ✓ | 1910-153 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
|  | 2 | 47 | 15 |  |  |  |  |  |  |  |  |  |  | Spare |
| H | 3 | 48 | 0 | ✓ | 1915-63 | S/G | 1.77 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| H | 3 | 49 | 1 | ✓ | 1925-64 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 50 | 2 | ✓ | 1925-65 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 51 | 3 | ✓ | 1930-66 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
|  | 3 | 52 | 4 |  | 1930-67 | S/G | 1.95 | M |  |  |  |  |  | 0 |
|  | 3 | 53 | 5 |  | 1930-68 | S/G | 1.95 | M |  |  |  |  |  | 0 |
|  | 3 | 54 | 6 | ✓ | 1930-154 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 55 | 7 | ✓ | 1930-155 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 56 | 8 | ✓ | 1930-156 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 57 | 9 | ✓ | 1935-69 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 58 | 10 | ✓ | 1935-70 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 59 | 11 | ✓ | 1945-71 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 3 | 60 | 12 | ✓ | 1945-72 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
|  | 3 | 61 | 13 |  |  |  |  |  |  |  |  |  |  | Spare |
|  | 3 | 62 | 14 |  | 1950-74 | S/G | 1.95 | M |  | ✓ |  | ✓ | ✓ | 0 |
| H | 3 | 63 | 15 | ✓ | 1950-75 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
|  | 4 | 64 | 0 |  | 1950-76 | S/G | 1.96 | M |  |  |  |  |  | 0 |
|  | 4 | 65 | 1 |  | 1950-77 | S/G | 1.96 | M |  |  |  |  |  | 0 |
| H | 4 | 66 | 2 | ✓ | 1950-157 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 4 | 67 | 3 | ✓ | 1950-158 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 4 | 68 | 4 | ✓ | 1955-78 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 4 | 69 | 5 | ✓ | 1955-79 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 4 | 70 | 6 | ✓ | 1965-80 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 4 | 71 | 7 | ✓ | 1970-81 | S/G | 1.90 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 4 | 72 | 8 | ✓ | 1970-82 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 4 | 73 | 9 | ✓ | 1970-83 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 4 | 74 | 10 | ✓ | 1970-159 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 4 | 75 | 11 | ✓ | 1970-160 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 4 | 76 | 12 | ✓ | 1975-84 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
|  | 4 | 77 | 13 |  | 1985-85 | S/G | 1.90 | M |  |  |  |  |  | 0 |
| H | 4 | 78 | 14 | ✓ | 1990-86 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
|  | 4 | 79 | 15 |  | 1995-87 | S/G | 1.96 | M |  |  |  |  |  | 0 |
|  | 5 | 80 | 0 | ✓ | 1830-143 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |

# M.V. ARCTIC DATA ACQUISITION SYSTEM

## DESIGN SYSTEM CHARACTERISTICS

(FOR CURRENT STATUS OF SENSORS REFER TO MOST RECENT REPORT)

| | BIN NO. | CH. NO. | CARD NO. | ADD. OKAY | SENSOR | | | | AMPLIFIER CARD | | | | RANGE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | REF. NO. | TYPE | SENSITIVITY | | GAIN | | V REF. | | | |
| H | 5 | 81 | 1 | ✓ | 1830-131 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 5 | 82 | 2 | ✓ | 1830-144 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 5 | 83 | 3 | ✓ | 1830-145 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 5 | 84 | 4 | ✓ | 1830-132 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 5 | 85 | 5 | ✓ | 1835-30 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 5 | 86 | 6 | ✓ | 1845-31 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| | 5 | 87 | 7 | | 1850-32 | S/G | 1.95 | M | | | | | | 0 |
| | 5 | 88 | 8 | | 1850-33 | S/G | 1.77 | M | | | | | | R |
| H | 5 | 89 | 9 | ✓ | 1850-34 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 5 | 90 | 10 | ✓ | 1850-35 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 5 | 91 | 11 | ✓ | 1850-36 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| | 5 | 92 | 12 | | 1850-37 | S/G | 1.96 | M | | | | | | 0 |
| | 5 | 93 | 13 | | 1850-133 | S/G | 1.77 | M | | | | | | 0 |
| | 5 | 94 | 14 | | 1850-134 | S/G | 1.83 | M | | | | | | Hamburg |
| H | 5 | 95 | 15 | ✓ | 1850-135 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | | Hamburg |
| H | 6 | 96 | 0 | ✓ | 1850-136 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 97 | 1 | ✓ | 1850-137 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 98 | 2 | ✓ | 1850-138 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 99 | 3 | ✓ | 1850-139 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | | Hamburg |
| H | 6 | 100 | 4 | ✓ | 1855-38 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | | Hamburg |
| H | 6 | 101 | 5 | ✓ | 1840-201 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 102 | 6 | ✓ | 1850-202 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 103 | 7 | ✓ | 1850-203 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 104 | 8 | ✓ | 1850-204 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 105 | 9 | ✓ | 1840-93 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 106 | 10 | ✓ | 1840-94 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 6 | 107 | 11 | | 1840-95 | S/G | 1.83 | M | | | | | | Hamburg |
| H | 6 | 108 | 12 | NC | 1840-96 | S/G | 1.96 | M | | ✓ | 5 | ✓ | | 0 |
| | 6 | 109 | 13 | | 1865-39 | S/G | 1.77 | M | | | | | | R |
| H | 6 | 110 | 14 | ✓ | 1865-40 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 6 | 111 | 15 | ✓ | 1870-41 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 7 | 112 | 0 | ✓ | 1870-42 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 7 | 113 | 1 | ✓ | 1870-43 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| | 7 | 114 | 2 | | 1870-44 | S/G | 1.96 | M | | | | | | 0 |
| H | 7 | 115 | 3 | ✓ | 1870-140 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 7 | 116 | 4 | ✓ | 1870-141 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 7 | 117 | 5 | ✓ | 1870-142 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 7 | 118 | 6 | ✓ | 1875-46 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 7 | 119 | 7 | | 1885-51 | S/G | 1.77 | M | | | | | | R |
| | 7 | 120 | 8 | NC | 1890-52 | S/G | 1.83 | M | | ✓ | 5 | ✓ | | Hamburg |

M.V. ARCTIC DATA ACQUISITION SYSTEM

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| | BIN NO. | CH. NO. | CARD NO. | ADD. OKAY | SENSOR | | SENSITIVITY | | AMPLIFIER CARD | | | | RANGE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | REF. NO. | TYPE | | | GAIN | | V REF. | | | |
| H | 7 | 121 | 9 | ✓ | 1890-53 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 7 | 122 | 10 | NC | 1890-54 | S/G | 1.83 | M | | | | | | Hamburg |
| | 7 | 123 | 11 | | 1890-55 | S/G | 1.95 | M | | | | | | 0 |
| | 7 | 124 | 12 | | 1890-56 | S/G | 1.95 | M | | | | | | 0 |
| | 7 | 125 | 13 | | 1890-167 | S/G | 1.77 | M | | | | | | R |
| H | 7 | 126 | 14 | ✓ | 1890-148 | S/G | 1.95 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| H | 7 | 127 | 15 | ✓ | 1840-50 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 8 | 128 | 0 | ✓ | 1785-1 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 8 | 129 | 1 | ✓ | 1790-2 | S/G | 1.77 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| | 8 | 130 | 2 | | 1790-3 | S/G | 1.77 | M | | | | | | R |
| H | 8 | 131 | 3 | ✓ | 1790-4 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 8 | 132 | 4 | ✓ | 1790-5 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| | 8 | 133 | 5 | ✓ | 1790-6 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 8 | 134 | 6 | ✓ | 1790-7 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 8 | 135 | 7 | | 1790-121 | S/G | 1.77 | M | | | | | | R |
| H | 8 | 136 | 8 | ✓ | 1790-122 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 8 | 137 | 9 | | 1790-123 | S/G | 1.96 | M | | | | | | 0 |
| H | 8 | 138 | 10 | ✓ | 1790-124 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 8 | 139 | 11 | ✓ | 1795-8 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 8 | 140 | 12 | ✓ | 1805-9 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 8 | 141 | 13 | | 1810-10 | S/G | 1.95 | M | | | | | | 0 |
| | 8 | 142 | 14 | | 1810-11 | S/G | 1.77 | M | | | | | | R |
| | 8 | 143 | 15 | | | | | | | | | | | Spare |
| | 9 | 144 | 0 | | 1810-12 | S/G | 1.77 | M | | | | | | R |
| H | 9 | 145 | 1 | ✓ | 1810-13 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 9 | 146 | 2 | | 1810-125 | S/G | 1.77 | M | | | | | | R |
| H | 9 | 147 | 3 | ✓ | 1810-126 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 9 | 148 | 4 | ✓ | 1810-127 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 9 | 149 | 5 | ✓ | 1810-128 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 9 | 150 | 6 | | 1810-14 | S/G | 1.83 | M | | | | | | Hamburg |
| | 9 | 151 | 7 | | 1810-15 | S/G | 1.96 | M | | | | | | 0 |
| H | 9 | 152 | 8 | ✓ | 1810-16 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 9 | 153 | 9 | ✓ | 1825-17 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 9 | 154 | 10 | | 1830-18 | S/G | 1.77 | M | | | | | | R |
| H | 9 | 155 | 11 | ✓ | 1830-19 | S/G | 1.77 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| | 9 | 156 | 12 | | 1830-20 | | 1.77 | M | | | | | | R |
| H | 9 | 157 | 13 | ✓ | 1830-21 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 9 | 158 | 14 | ✓ | 1830-22 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| | 9 | 159 | 15 | | | | | | | | | | | Spare |
| | 10 | 160 | 0 | ✓ | 1830-23 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |

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| | BIN NO. | CH. NO. | CARD NO. | ADD. OKAY | SENSOR | | | | AMPLIFIER CARD | | | | RANGE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | REF. NO. | TYPE | SENSITIVITY | | GAIN | | V REF. | | | |
| H | 10 | 161 | 1 | ✓ | 1830-24 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 10 | 162 | 2 | ✓ | 1830-25 | S/G | 1.94 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 10 | 163 | 3 | ✓ | 1830-26 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| | 10 | 164 | 4 | | 1830-27 | S/G | 1.96 | M | | | | | | 0 |
| | 10 | 165 | 5 | | 1830-28 | S/G | 1.96 | M | | | | | | 0 |
| H | 10 | 166 | 6 | ✓ | 1830-29 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| H | 10 | 167 | 7 | ✓ | 1825-191 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 10 | 168 | 8 | | 1825-192 | S/G | 1.83 | M | | | | | | Hamburg |
| H | 10 | 169 | 9 | ✓ | 1830-193 | S/G | 1.83 | M | 500 | ✓ | 5 | ✓ | ✓ | Hamburg |
| H | 10 | 170 | 10 | ✓ | 1830-194 | S/G | 1.96 | M | 500 | ✓ | 5 | ✓ | ✓ | 0 |
| | 10 | 171 | 11 | | Temperature Therm. | | | | | | | | | |
| | 10 | 172 | 12 | | Temperature Therm. | | | | | | | | | |
| | 10 | 173 | 13 | | 1830-129 | S/G | 1.83 | M | | | | | | Hamburg |
| | 10 | 174 | 14 | | 1830-130 | S/G | 1.77 | M | 500 | ✓ | 5 | ✓ | ✓ | R |
| | 10 | 175 | 15 | | | | | | | | | | | Spare |
| | 11 | 176 | 0 | | 1035- | S/G | | | | | | | | |
| | 11 | 177 | 1 | | 1045- | S/G | | | | | | | | |
| | 11 | 178 | 2 | | 1055- | S/G | | | | | | | | |
| | 11 | 179 | 3 | | 1055- | S/G | | | | | | | | |
| | 11 | 180 | 4 | | 1055- | S/G | | | | | | | | |
| | 11 | 181 | 5 | | 1055- | S/G | | | | | | | | |
| | 11 | 182 | 6 | | 1055- | S/G | | | | | | | | |
| | 11 | 183 | 7 | | 1055- | S/G | | | | | | | | |
| | 11 | 184 | 8 | | 1065- | S/G | | | | | | | | |
| | 11 | 185 | 9 | | 1075- | S/G | | | | | | | | |
| | 11 | 186 | 10 | | | | | | | | | | | Spare |
| | 11 | 187 | 11 | | Bubbler | Press. | 1.5 mV/psi | M | 330 | ✓ | 0 | ✓ | 0→20psi | |
| | 11 | 188 | 12 | | Bubbler | Press. | 1.5 mV/psi | M | 330 | ✓ | 0 | ✓ | 0→20psi | |
| | 11 | 189 | 13 | | | | | | | | | | | Spare |
| | 11 | 190 | 14 | | | | | | | | | | | Spare |
| | 11 | 191 | 15 | | | | | | | | | | | Spare |
| | 12 | 192 | 0 | | | | | | | | | | | Spare |
| | 12 | 193 | 1 | | | | | | | | | | | Spare |
| | 12 | 194 | 2 | | | | | | | | | | | Spare |
| | 12 | 195 | 3 | | | | | | | | | | | Spare |
| | 12 | 196 | 4 | | | | | | | | | | | Spare |
| | 12 | 197 | 5 | | | | | | | | | | | Spare |
| | 12 | 198 | 6 | ✓ | Thrust | Renk | 1V/12t | M | 0.5 | ✓ | 5 | ✓ | ±120t | |
| | 12 | 199 | 7 | ✓ | Fuel Rack Pot. | | | | 1 | ✓ | 0 | ✓ | | |
| | 12 | 200 | 8 | ✓ | Rudder Res. Pot. | | | | 1 | ✓ | 0 | ✓ | ±40° | |

## M.V. ARCTIC DATA ACQUISITION SYSTEM

## DESIGN SYSTEM CHARACTERISTICS

(FOR CURRENT STATUS OF SENSORS REFER TO MOST RECENT REPORT)

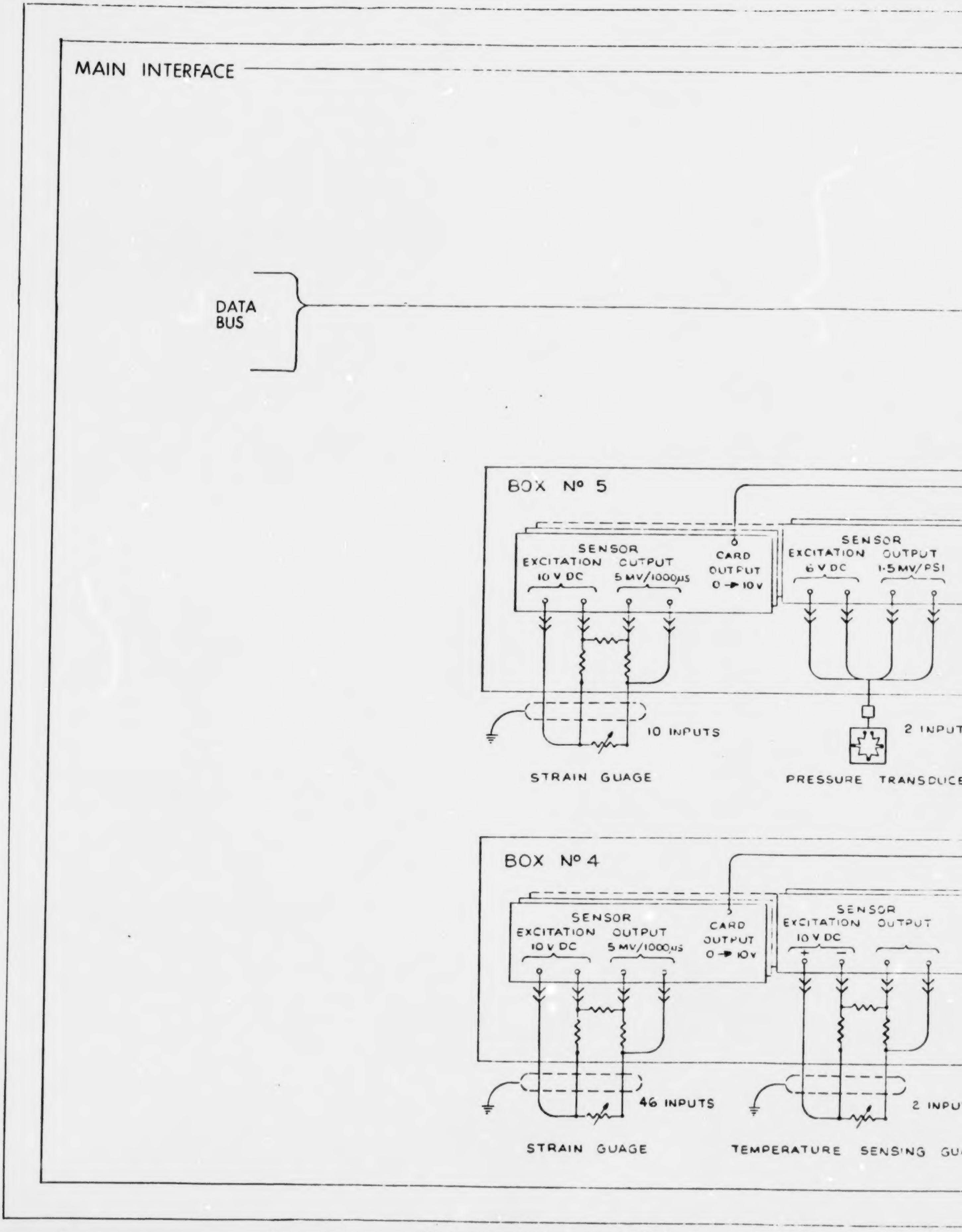
| BIN NO. | CH. NO. | CARD NO. | ADD. OKAY | SENSOR | | | | AMPLIFIER CARD | | | | RANGE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | REF. NO. | TYPE | SENSITIVITY | | GAIN | | V REF. | | | |
| 12 | 201 | 9 | ✓ | Prop. Res. | Pot. | | | 1 | ✓ | 0 | ✓ | | See Note |
| 12 | 202 | 10 | ✓ | Rud. D.P. | Press. | 1V/5000 psi | M | 5 | ✓ | 5 | ✓ | ±5000psi | |
| 12 | 203 | 11 | ✓ | Prop. D.P. | Press. | 1V/2000 psi | M | 5 | | 5 | | | |
| 12 | 204 | 12 | ✓ | Bub.Stat. | Relay | | | | | | | | |
| 12 | 205 | 13 | ✓ | Bub.Stat. | Relay | | | | | | | | |
| 12 | 206 | 14 | ✓ | Bub.Stat. | Relay | | | | | | | | |
| 12 | 207 | 15 | | | | | | | | | | | Spare |
| 13 | 208 | 0 | ✓ | Torque | T.M. | ? | | 10 | ✓ | 5 | ✓ | X | See Note |
| 13 | 209 | 1 | | | | | | | | | | | Spare |
| 13 | 210 | 2 | | | | | | | | | | | Spare |
| 13 | 211 | 3 | | | | | | | | | | | Spare |
| 13 | 212 | 4 | ✓ | Surge | ACC | 10.1 mV/g | M | | | 5 | ✓ | ±2.5 g | See Note |
| 13 | 213 | 5 | ✓ | Sway | ACC | 10.7 mV/g | M | | | 5 | ✓ | ±2.5 g | See Note |
| 13 | 214 | 6 | ✓ | Heave | ACC | 10.7 mV/g | M | | | 5 | ✓ | ±2.5 g | See Note |
| 13 | 215 | 7 | | | | | | | | | | | Spare |
| 13 | 216 | 8 | | | | | | | | | | | Spare |
| 13 | 217 | 9 | | | | | | | | | | | Spare |
| 13 | 218 | 10 | | | | | | | | | | | Spare |
| 13 | 219 | 11 | | | | | | | | | | | Spare |
| 13 | 220 | 12 | | | | | | | | | | | Spare |
| 13 | 221 | 13 | | | | | | | | | | | Spare |
| 13 | 222 | 14 | | | | | | | | | | | Spare |
| 13 | 223 | 15 | | | | | | | | | | | Spare |
| 14 | 224 | 0 | ✓ | Visibility | Mar. | 0.5 V/mile | ✓ | 2 | ✓ | 0 | ✓ | 0→10 | Miles |
| 14 | 225 | 1 | ✓ | Cloud C. | Mar. | 0.5 V/tenth | ✓ | 2 | ✓ | 0 | ✓ | 0→10 | Tenths |
| 14 | 226 | 2 | ✓ | Ice C. | Mar. | 0.5 V/tenth | ✓ | 2 | ✓ | 0 | ✓ | 0→10 | Tenths |
| 14 | 227 | 3 | | | | | | | | | | | Spare |
| 14 | 228 | 4 | ✓ | Bar.Press. | Mar. | 0.5 V/unit | ✓ | 2 | ✓ | 0 | ✓ | 0→9 | m bars |
| 14 | 229 | 5 | ✓ | Bar.Press. | Mar. | 0.5 V/ten | ✓ | 2 | ✓ | 0 | ✓ | 0→90 | m bars |
| 14 | 230 | 6 | ✓ | Bar.Press. | Mar. | Switch | ✓ | 2 | ✓ | 0 | ✓ | 900/1000 m bars | |
| 14 | 231 | 7 | ✓ | Air Temp. | Mar. | 0.05 V/°C | ✓ | 1 | ✓ | 5 | ✓ | ±100°C | |
| 14 | 232 | 8 | ✓ | Rel.Humid. | Mar. | 0.05 V/% | ✓ | 2 | ✓ | 0 | ✓ | 0→100% | |
| 14 | 233 | 9 | ✓ | Wind Speed | Tech. | | ✓ | | | | | X | |
| 14 | 234 | 10 | ✓ | Wind Dir. | Synchro. | | ✓ | | | | | 0→360° | |
| 14 | 235 | 11 | | | | | | | | | | | Spare |
| 14 | 236 | 12 | ✓ | Ship Speed | Doppler | | | 1 | ✓ | 0 | ✓ | | |
| 14 | 237 | 13 | ✓ | ShipHead:S | Pot. | | | | | | | | |
| 14 | 238 | 14 | ✓ | ShipHead:C | Pot. | | | | | | | | |
| 14 | 239 | 15 | ✓ | Pitch | Pot. | | | 10 | ✓ | 5 | ✓ | | |
| 15 | 240 | 0 | ✓ | Roll | Pot | | | 10 | ✓ | 5 | ✓ | | |

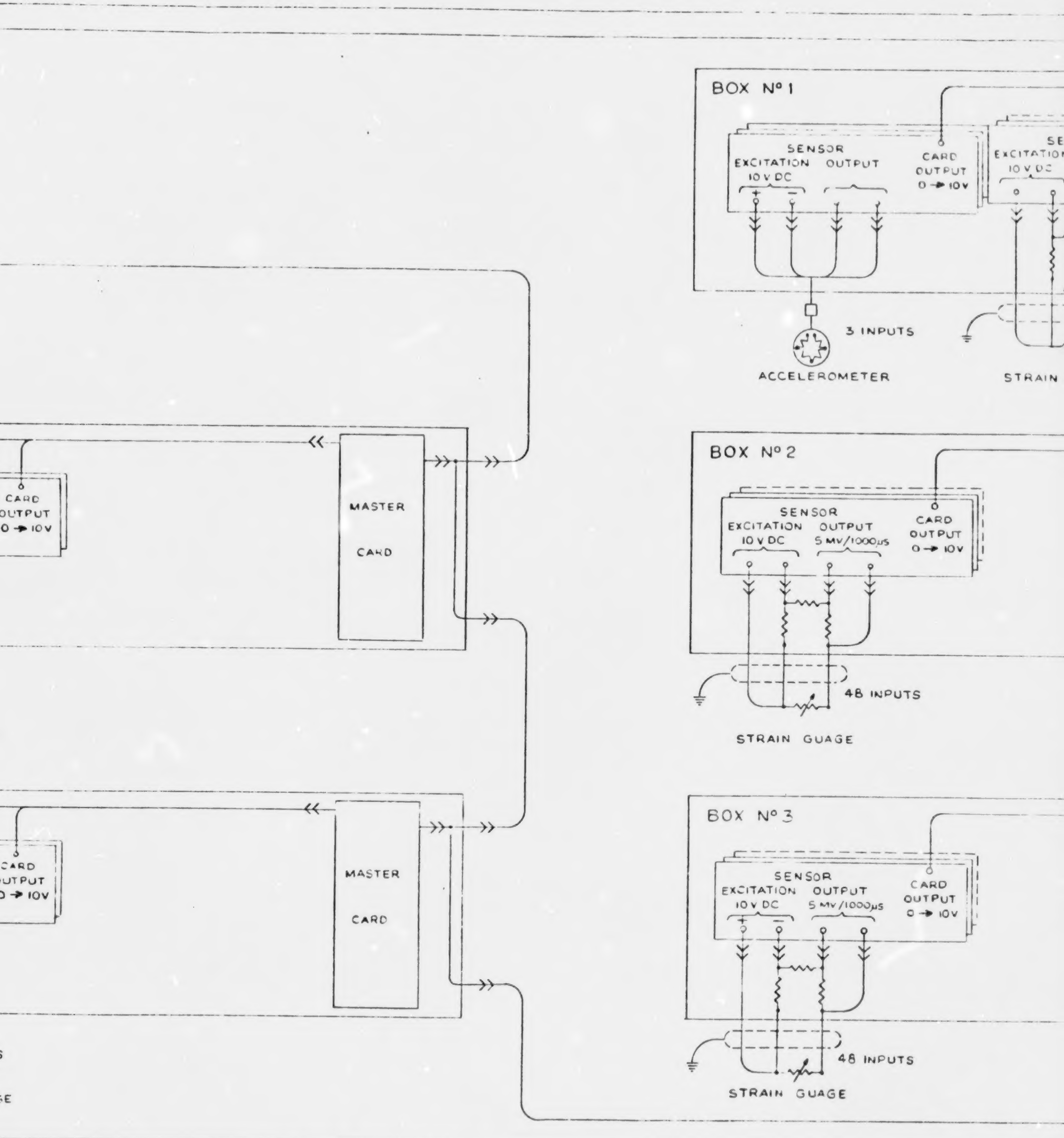
M.V. ARCTIC DATA ACQUISITION SYSTEM

DESIGN SYSTEM CHARACTERISTICS

(FOR CURRENT STATUS OF SENSORS REFER TO MOST RECENT REPORT)

| BIN NO. | CH. NO. | CARD NO. | ADD. OKAY | SENSOR |  | AMPLIFIER CARD |  |  |  |  | RANGE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | REF. NO. | TYPE | SENSITIVITY | GAIN |  | V REF. |  |  |  |
| 15 | 241 | 1 |  | Engine RPM |  |  |  |  |  |  |  |  |
| 15 | 242 | 2 | ✓ | Shaft RPM | Tech. |  |  |  |  |  |  |  |
| 15 | 243 | 3 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 244 | 4 | ✓ | Prop.Com. | Pot. |  |  |  |  |  |  |  |
| 15 | 245 | 5 | ✓ | Rud.Com. | Pot. |  |  |  |  |  | ±40° |  |
| 15 | 246 | 6 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 247 | 7 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 248 | 8 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 249 | 9 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 250 | 10 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 251 | 11 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 252 | 12 | ✓ | Draft(fwd) | Mar. |  | 2 | ✓ | 0 | ✓ |  |  |
| 15 | 253 | 13 | ✓ | Draft(aft) | Mar. |  | 2 | ✓ | 0 | ✓ |  |  |
| 15 | 254 | 14 |  |  |  |  |  |  |  |  |  | Spare |
| 15 | 255 | 15 | ✓ | Event | Switch |  |  |  |  |  |  |  |


MAIN INTERFACE
DATA BUS
BOX Nº 5
SENSOR
EXCITATION
10 V DC
OUTPUT
5 MV/1000µs
CARD OUTPUT
0 → 10 V
SENSOR
EXCITATION
6 V DC
OUTPUT
1·5 MV/PSI
10 INPUTS
STRAIN GUAGE
2 INPUT
PRESSURE TRANSDUCE
BOX Nº 4
SENSOR
EXCITATION
10 V DC
OUTPUT
5 MV/1000µs
CARD OUTPUT
0 → 10 V
SENSOR
EXCITATION
10 V DC
+
−
OUTPUT
46 INPUTS
STRAIN GUAGE
2 INPU
TEMPERATURE SENSING GU


BOX Nº 1
SENSOR
EXCITATION
10 V DC
+
−
OUTPUT
CARD
OUTPUT
0 → 10V
3 INPUTS
ACCELEROMETER
STRAIN
CARD
OUTPUT
0 → 10V
MASTER
CARD
BOX Nº 2
SENSOR
EXCITATION
10 V DC
OUTPUT
5 MV/1000μS
CARD
OUTPUT
0 → 10V
48 INPUTS
STRAIN GUAGE
BOX Nº 3
SENSOR
EXCITATION
10 V DC
+
−
OUTPUT
5 MV/1000μS
CARD
OUTPUT
0 → 10V
48 INPUTS
STRAIN GUAGE
CARD
OUTPUT
0 → 10V
MASTER
CARD

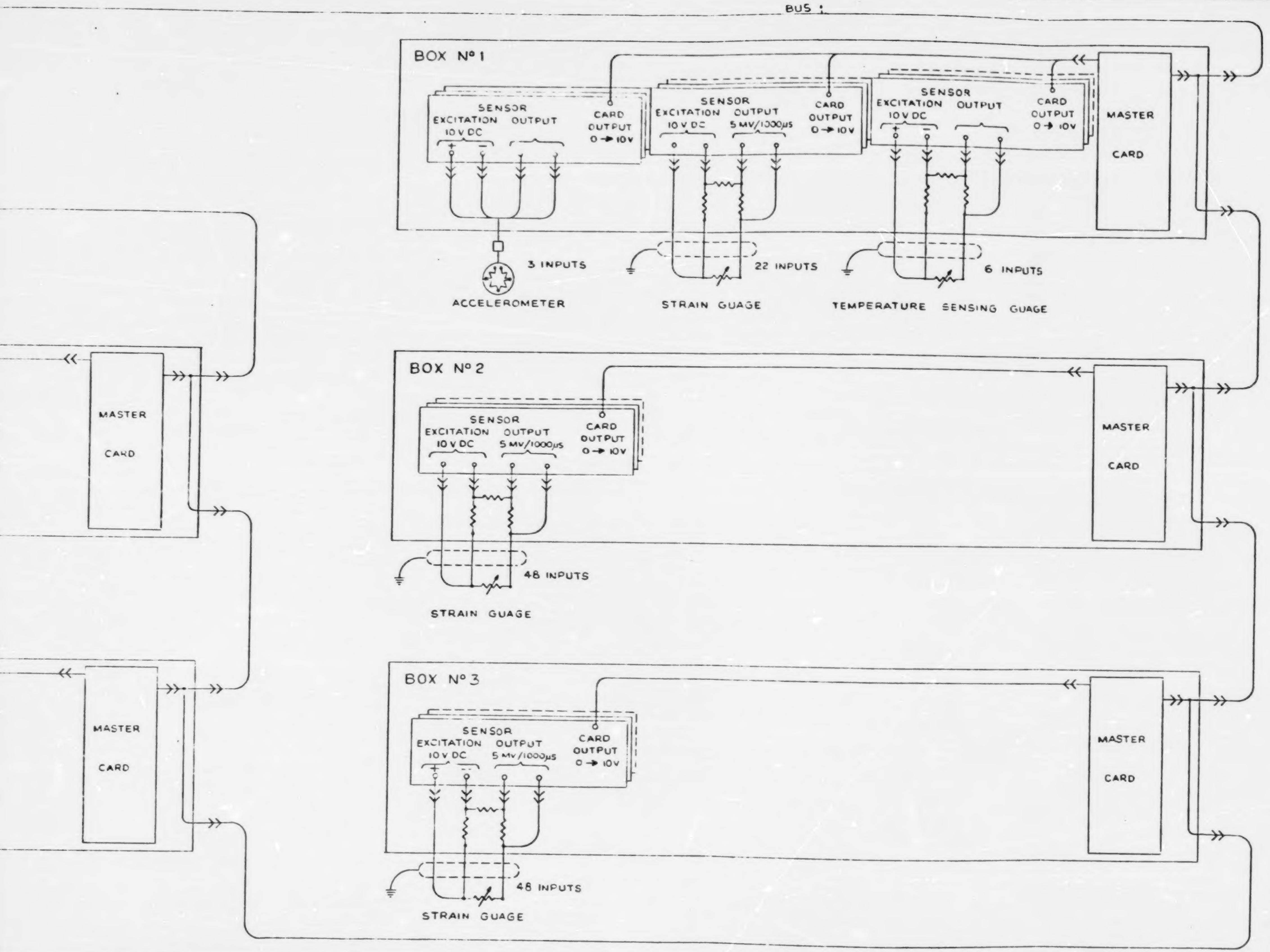

BUS :
BOX Nº 1
SENSOR
EXCITATION
10 V DC
OUTPUT
CARD
OUTPUT
0 → 10V
SENSOR
EXCITATION
10 V DC
OUTPUT
5 MV/1000µS
CARD
OUTPUT
0 → 10V
SENSOR
EXCITATION
10 V DC
OUTPUT
CARD
OUTPUT
0 → 10V
MASTER
CARD
3 INPUTS
ACCELEROMETER
22 INPUTS
STRAIN GUAGE
6 INPUTS
TEMPERATURE SENSING GUAGE
BOX Nº 2
SENSOR
EXCITATION
10 V DC
OUTPUT
5 MV/1000µS
CARD
OUTPUT
0 → 10V
MASTER
CARD
48 INPUTS
STRAIN GUAGE
BOX Nº 3
SENSOR
EXCITATION
10 V DC
OUTPUT
5 MV/1000µS
CARD
OUTPUT
0 → 10V
MASTER
CARD
48 INPUTS
STRAIN GUAGE
MASTER
CARD
MASTER
CARD

FIGURE 7

german + milne
Marine Transportation Consultants
Naval Architects
Montreal

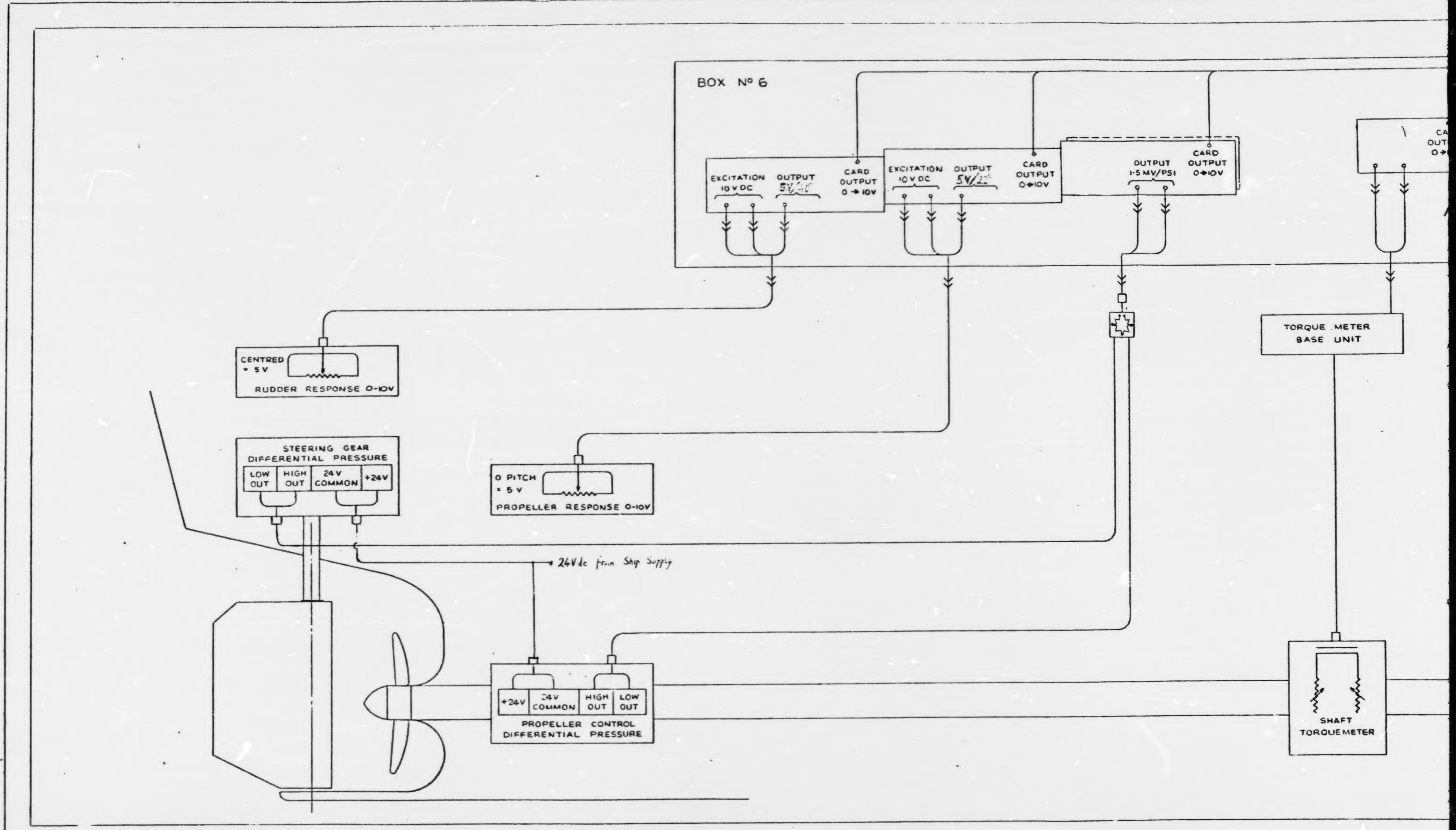
M.V. 'ARCTIC'

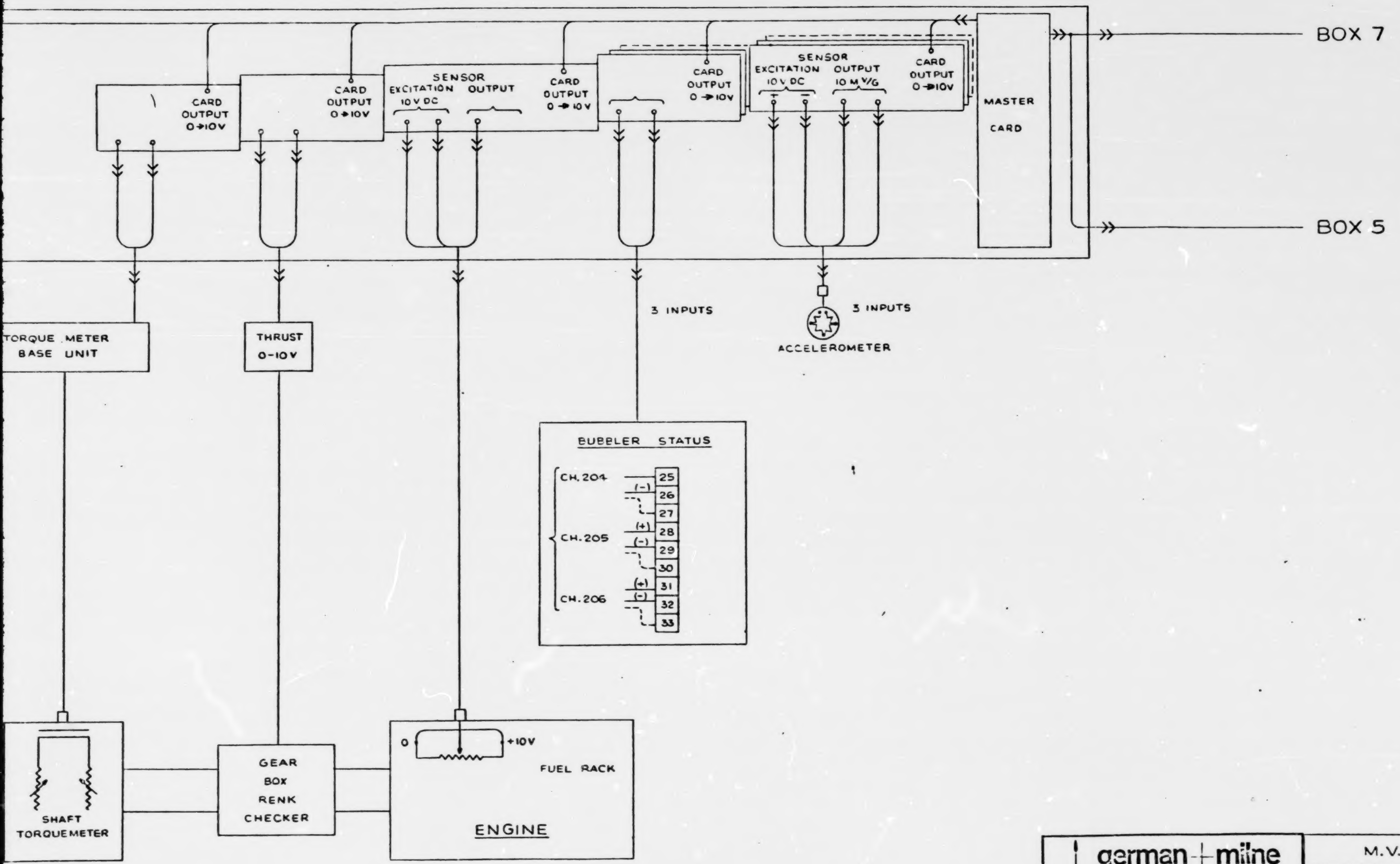
DATE : MARCH 1979

DATA ACQUISITION
SYSTEM SCHEMATIC
SHEET 1 OF 4

DRAWN : K.J.R.

DWG Nº : 3501-101

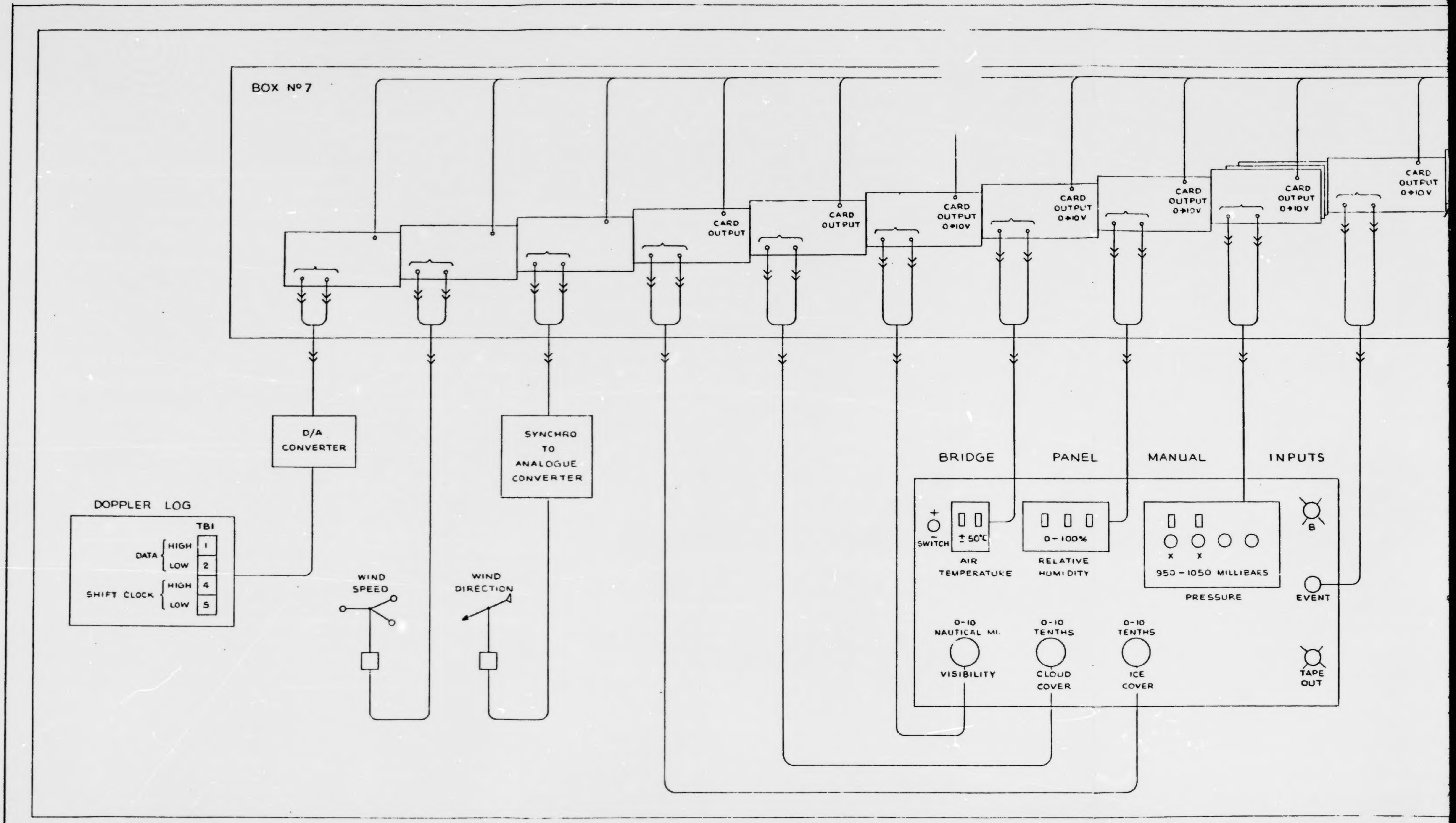

BOX Nº 6
EXCITATION 10 V DC
OUTPUT 5V/40°
CARD OUTPUT 0 → 10V
EXCITATION 10 V DC
OUTPUT 5V/22°
CARD OUTPUT 0→10V
OUTPUT 1·5 MV/PSI
CARD OUTPUT 0→10V
CA
OUT
0→
CENTRED = 5 V
RUDDER RESPONSE 0-10V
STEERING GEAR DIFFERENTIAL PRESSURE
LOW OUT
HIGH OUT
24 V COMMON
+24V
0 PITCH = 5 V
PROPELLER RESPONSE 0-10V
24V dc from Ship Supply
TORQUE METER BASE UNIT
+24V
24 V COMMON
HIGH OUT
LOW OUT
PROPELLER CONTROL DIFFERENTIAL PRESSURE
SHAFT TORQUEMETER

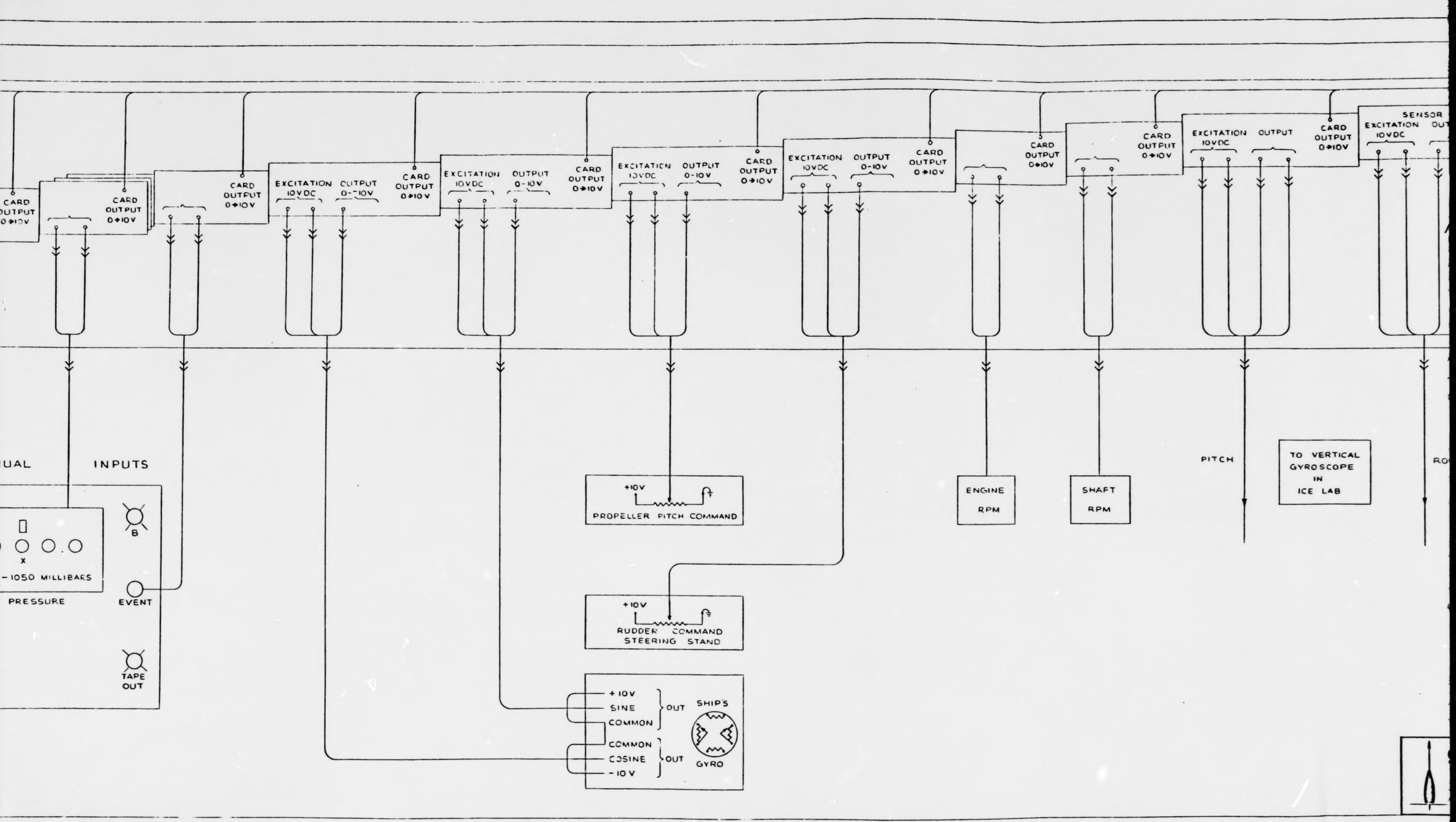


CARD
OUTPUT
0→10V
CARD
OUTPUT
0→10V
SENSOR
EXCITATION
10 V DC
OUTPUT
CARD
OUTPUT
0 → 10 V
CARD
OUTPUT
0 → 10V
SENSOR
EXCITATION
10 V DC
+
−
OUTPUT
10 M V/G
CARD
OUTPUT
0 →10V
MASTER
CARD
BOX 7
BOX 5
3 INPUTS
3 INPUTS
ACCELEROMETER
TORQUE METER
BASE UNIT
THRUST
0-10V
BUBBLER STATUS
CH. 204
CH. 205
CH. 206
(−)
(+)
(−)
(+)
(−)
25
26
27
28
29
30
31
32
33
SHAFT
TORQUEMETER
GEAR
BOX
RENK
CHECKER
0
+10V
FUEL RACK
ENGINE

FIGURE 8

| german + milne<br>Marine Transportation Consultants<br>Naval Architects<br>Montreal | M.V. 'ARCTIC' | DATE: MARCH 1979 |
|---|---|---|
| | DATA ACQUISITION SYSTEM SCHEMATIC<br>SHEET 2 OF 4 | DRAWN: K.E.R.<br>DWG Nº: 3531-101 |


BOX Nº 7
CARD OUTPUT
CARD OUTPUT
CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
D/A CONVERTER
SYNCHRO TO ANALOGUE CONVERTER
DOPPLER LOG
TBI
DATA HIGH 1
LOW 2
SHIFT CLOCK HIGH 4
LOW 5
WIND SPEED
WIND DIRECTION
BRIDGE PANEL MANUAL INPUTS
+
−
SWITCH
± 50°C
AIR TEMPERATURE
0 − 100%
RELATIVE HUMIDITY
X
X
950 − 1050 MILLIBARS
PRESSURE
B
EVENT
0-10 NAUTICAL MI.
VISIBILITY
0-10 TENTHS
CLOUD COVER
0-10 TENTHS
ICE COVER
TAPE OUT


CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
EXCITATION 10VDC
OUTPUT 0-10V
CARD OUTPUT 0→10V
EXCITATION 10VDC
OUTPUT 0-10V
CARD OUTPUT 0→10V
EXCITATION 10VDC
OUTPUT 0-10V
CARD OUTPUT 0→10V
EXCITATION 10VDC
OUTPUT 0-10V
CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
CARD OUTPUT 0→10V
EXCITATION 10VDC
OUTPUT
CARD OUTPUT 0→10V
SENSOR
EXCITATION 10VDC
OUT
UAL
INPUTS
X
-1050 MILLIBARS
PRESSURE
B
EVENT
TAPE OUT
+10V
PROPELLER PITCH COMMAND
+10V
RUDDER COMMAND STEERING STAND
+10V
SINE
COMMON
OUT
COMMON
COSINE
-10V
OUT
SHIP'S GYRO
ENGINE RPM
SHAFT RPM
PITCH
TO VERTICAL GYROSCOPE IN ICE LAB
RO

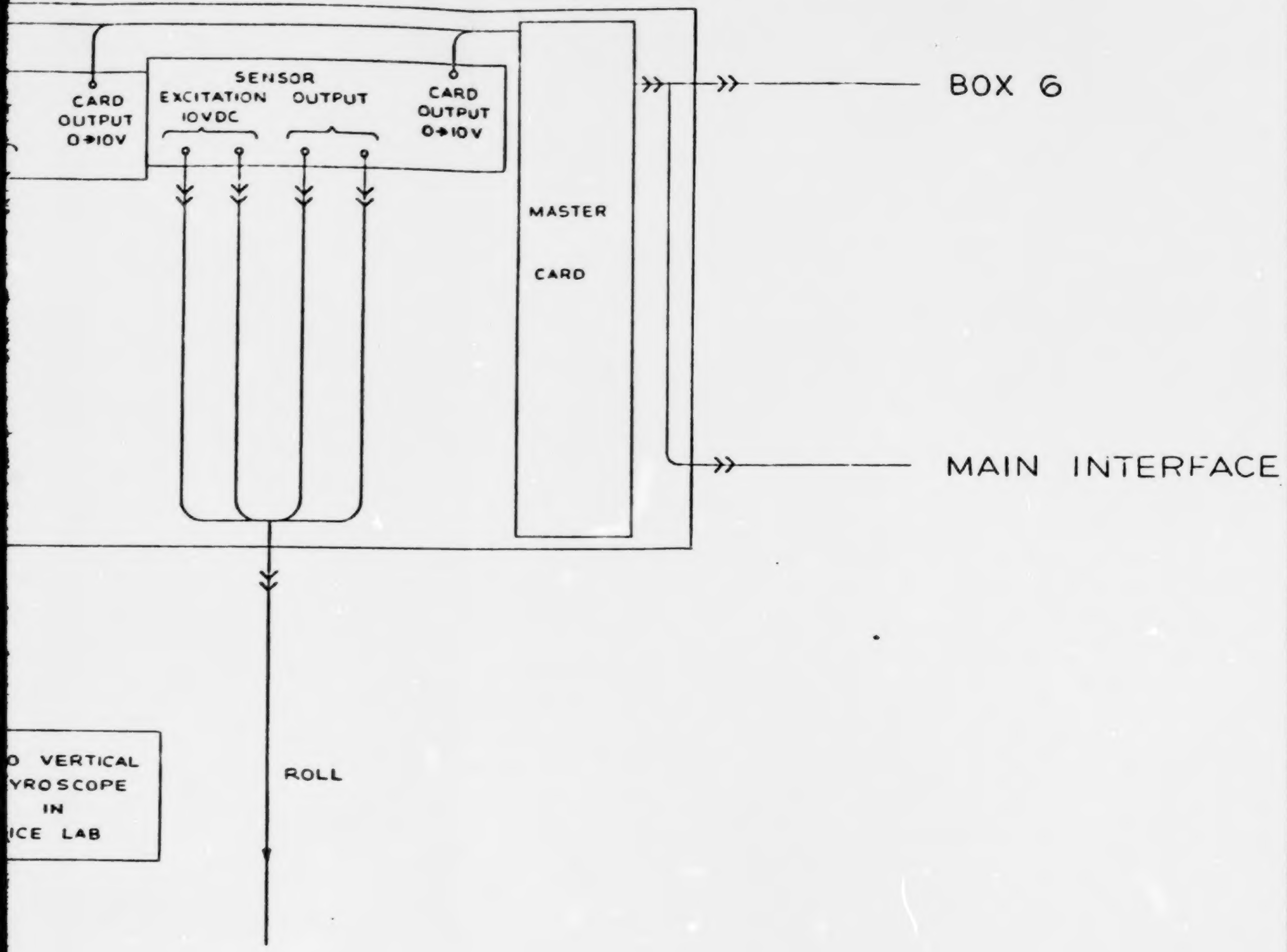
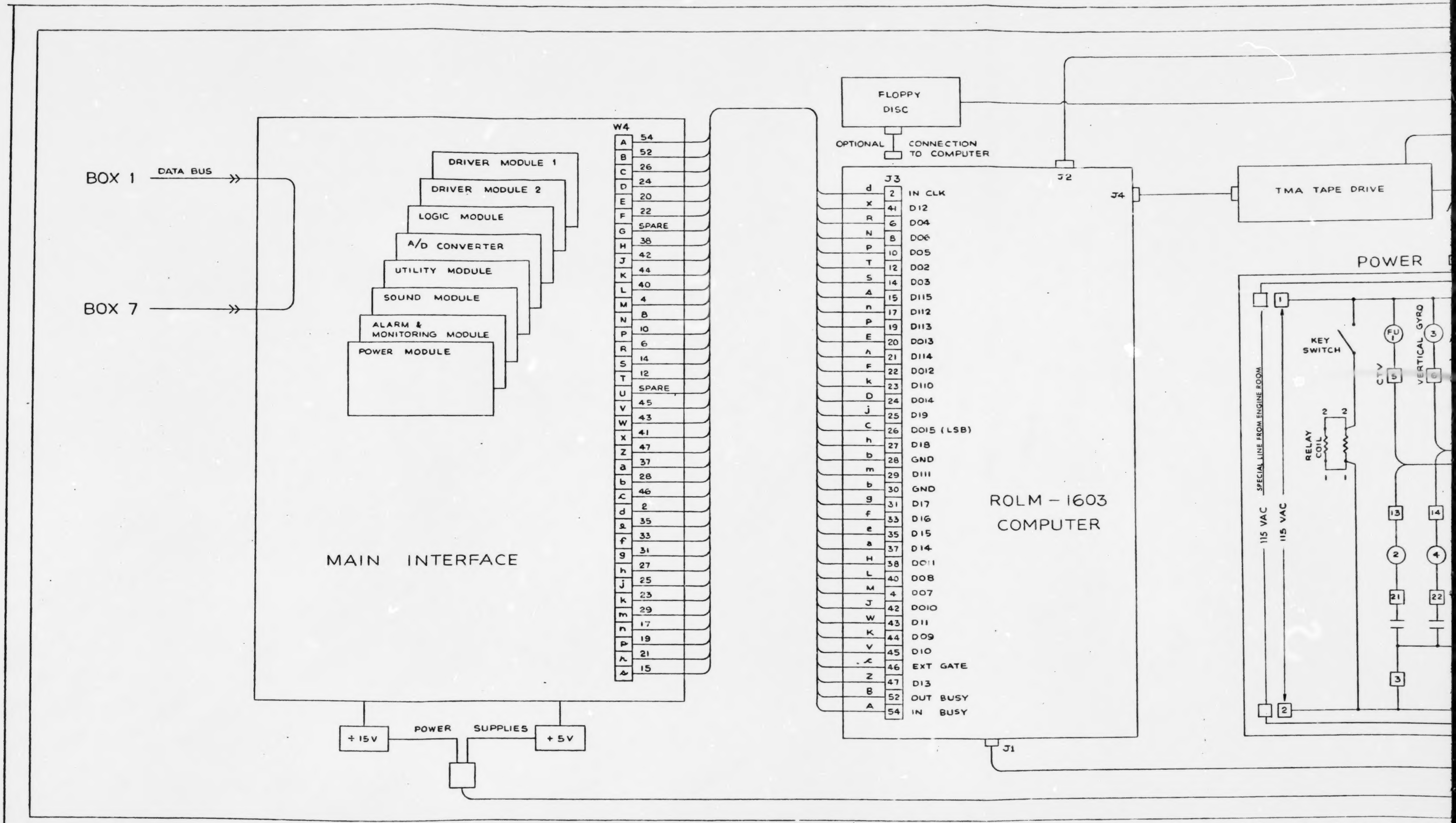

SENSOR
CARD OUTPUT 0→10V
EXCITATION 10VDC
OUTPUT
CARD OUTPUT 0→10V
MASTER CARD
BOX 6
MAIN INTERFACE
ROLL
O VERTICAL
YROSCOPE
IN
ICE LAB

**FIGURE 9**

| | | |
|---|---|---|
| german milne<br>Marine Transportation Consultants<br>Naval Architects<br>Montreal | M.V. 'ARCTIC' | DATE: MARCH 1979 |
| | DATA ACQUISITION SYSTEM SCHEMATIC<br>SHEET 3 OF 4 | DRAWN: K.J.R. |
| | | DWG No: 3501- 31 |


BOX 1
DATA BUS
BOX 7
DRIVER MODULE 1
DRIVER MODULE 2
LOGIC MODULE
A/D CONVERTER
UTILITY MODULE
SOUND MODULE
ALARM & MONITORING MODULE
POWER MODULE
MAIN INTERFACE
W4
A 54
B 52
C 26
D 24
E 20
F 22
G SPARE
H 38
J 42
K 44
L 40
M 4
N 8
P 10
R 6
S 14
T 12
U SPARE
V 45
W 43
X 41
Z 47
a 37
b 28
c 46
d 2
e 35
f 33
g 31
h 27
j 25
k 23
m 29
n 17
p 19
r 21
s 15
+15V
POWER SUPPLIES
+5V
FLOPPY DISC
OPTIONAL CONNECTION TO COMPUTER
J2
J3
d 2 IN CLK
x 41 DI2
R 6 DO4
N 8 DO6
P 10 DO5
T 12 DO2
S 14 DO3
A 15 DI15
n 17 DI12
p 19 DI13
E 20 DO13
r 21 DI14
F 22 DO12
k 23 DI10
D 24 DO14
j 25 DI9
C 26 DO15 (LSB)
h 27 DI8
b 28 GND
m 29 DI11
b 30 GND
g 31 DI7
f 33 DI6
e 35 DI5
a 37 DI4
H 38 DO11
L 40 DO8
M 4 DO7
J 42 DO10
W 43 DI1
K 44 DO9
V 45 DI0
c 46 EXT GATE
Z 47 DI3
B 52 OUT BUSY
A 54 IN BUSY
ROLM – 1603 COMPUTER
J1
J4
TMA TAPE DRIVE
POWER
1
2
SPECIAL LINE FROM ENGINE ROOM
115 VAC
115 VAC
KEY SWITCH
RELAY COIL
2 2
1 1
FU 1
CTV
5
VERTICAL GYRO
3
6
13
14
2
4
21
22
3

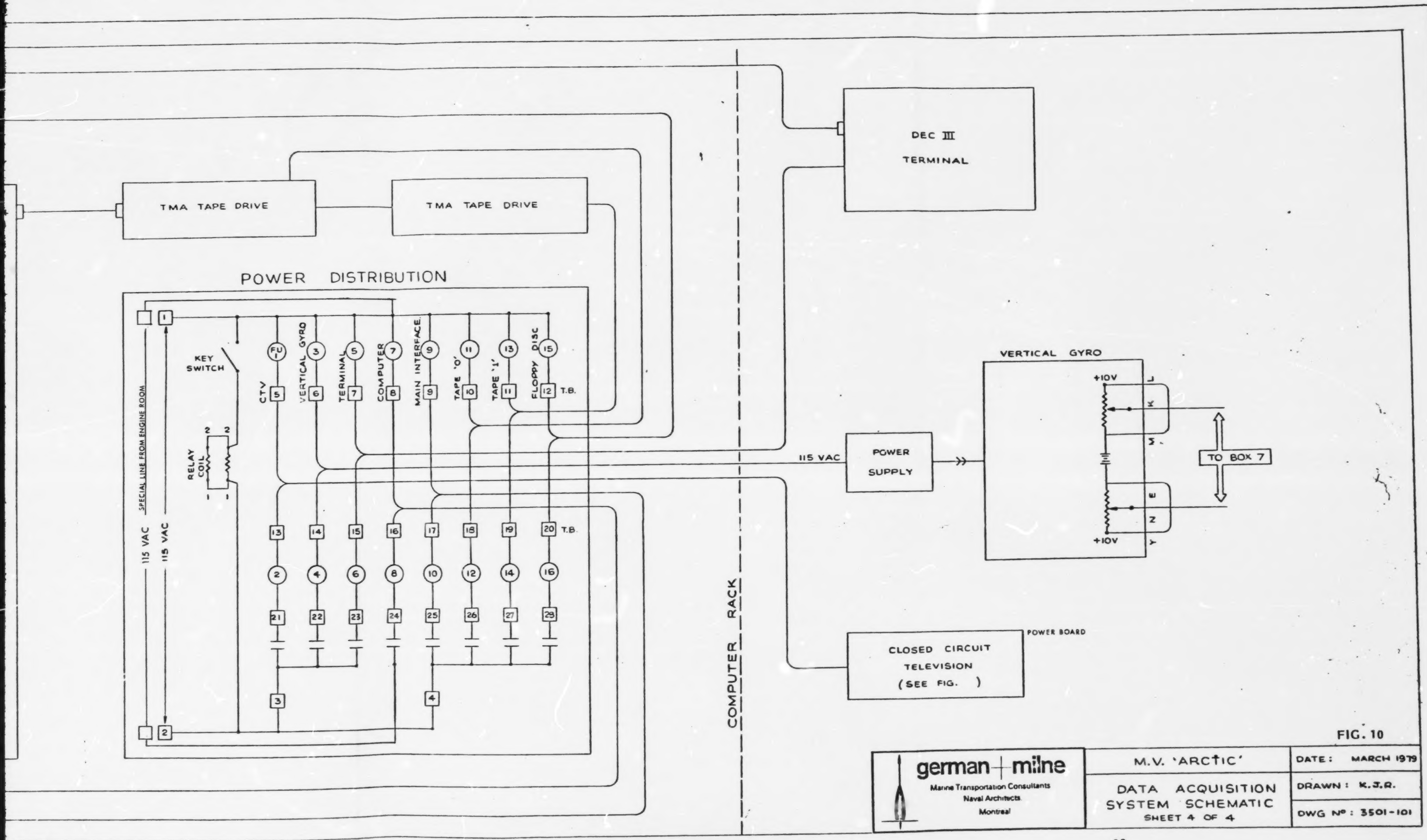

TMA TAPE DRIVE
TMA TAPE DRIVE
DEC III TERMINAL
POWER DISTRIBUTION
KEY SWITCH
RELAY COIL
2 2
SPECIAL LINE FROM ENGINE ROOM
115 VAC
115 VAC
1
2
FU 1
CTV
VERTICAL GYRO
TERMINAL
COMPUTER
MAIN INTERFACE
TAPE '0'
TAPE '1'
FLOPPY DISC
3 5 7 9 11 13 15
5 6 7 8 9 10 11 12 T.B.
13 14 15 16 17 18 19 20 T.B.
2 4 6 8 10 12 14 16
21 22 23 24 25 26 27 28
3
4
COMPUTER RACK
115 VAC
POWER SUPPLY
VERTICAL GYRO
+10V
+10V
L
K
M
E
Z
Y
TO BOX 7
CLOSED CIRCUIT TELEVISION (SEE FIG. )
POWER BOARD

FIG. 10

german + milne
Marine Transportation Consultants
Naval Architects
Montreal

M.V. 'ARCTIC'

DATA ACQUISITION SYSTEM SCHEMATIC
SHEET 4 OF 4

DATE: MARCH 1979
DRAWN: K.J.R.
DWG Nº: 3501-101

# PART II

# DETAILED DESCRIPTION

## LIST OF FIGURES

### Part II

Fig. 1.1 Strain Gauges
1.2 Effect of the "Auto Zero" Function
1.3 Strain Gauge Filter Cards
1.4 Location of Plate Strain Gauges
1.5 Location of Frame Strain Guages
1.6 Location of Thermistors at Fr. 193
1.7 Thermistors
1.8 Draft

2.1 Logic Diagram, Digital to Analog Converter, Doppler Speed Log
2.2 Ship Speed
2.3 Potentiometer Wiring Diagram
2.4 Connections: Gyro compass Control Unit to Box 7
2.5 Ship Head - Sine and Cosine
2.6 Pitch (Roll)
2.7 Connections to Gyro
2.8 Connections to Gyro
2.9 Accelerometers
2.10 Accelerometer Filter Cards

3.1 Propeller Command (Response)
3.2 Rudder Command (Response)
3.3 Differential Pressure
3.4 Fuel Rack
3.5 Thrust
3.6 Torque
3.7 Torquemeter Connections on the Shaft
3.8 Calibration of Torquemeter
3.9 Shaft R.P.M.

4.1 Bubbler Pressure
4.2 Layout Bubbler System
4.3 Schematic Thruster and Blow-off Translator
4.4 Schematic Bubbler Translator

5.1a Wiring Diagram, Manual Input circuit, Environmental Data
5.1b Terminal Block, Manual Input circuit, Environmental Data
5.2 Manual Inputs
5.3 Air Temperature
5.4 Wind Speed, Direction System
5.5 Connections, Wind Direction and Wind Speed
5.6 Wind Speed
5.7 Wind Direction

# LIST OF FIGURES

## Part II

Fig. 6.1 Master Card Circuit Diagram
6.2 Main Bus
6.3 Wiring Diagram, Box # 1
6.4 " " " # 2
6.5 " " " # 3
6.6 " " " # 4
6.7 " " " # 5
6.8 " " " # 6
6.9 " " " # 7

7.1 Wiring Diagram, Main Interface
7.2 Logic Diagram, Utility Module (Main Interface)
7.3 " " , Analog to Digital Convertor (Main Interface)
7.4 " " , Logic Module (Main Interface)
7.5 " " , Driver Module #1 (Main Interface)
7.6 " " , Driver Module #2 " "
7.7 " " , Alarm and Monitoring Module (Main Interface)
7.8 Circuit for Sound Module
7.9 Main Interface - Power Module
7.10 Timing Diagram for Old Interface
7.11 Timing Diagram for Old Interface
7.12 Timing Diagram for Old Interface
7.13 Circuit for Old Interface

8.1 Computer System Connections

# SECTION 1

# HULL STRUCTURE INSTRUMENTATION

## Section 1: Hull Structure Instrumentation

1.1 Strain Gauges

- 1.1.1 Circuit Details
- 1.1.2 Auto-Zero Circuit
- 1.1.3 Gauge Factor
- 1.1.4 Setting up procedure
- 1.1.5 Short Set-up Procedure
- 1.1.6 Low Pass Filters
- 1.1.7 Location of Strain Gauges
- 1.1.8 Mid-section Strain Gauges

1.2 Thermistors

- 1.2.1 Circuit Details
- 1.2.2 Calibration Information
- 1.2.3 Location of Thermistors

1.3 Draft

- 1.3.1 Circuit Details

## 1.1 Strain Gauges

Ailtech SG-129 strain gauges have been installed on the hull plates and frames at the bow of the ship, principally on the starboard side (see Fig. 1.4 & 1.5 for strain gauge locations). The gauges were installed at three different times: when the ship was being built; during repairs to the bow in 1978; and during a refit in Hamburg in 1980.

### 1.1.1 Circuit Details

The gauges have a nominal resistance of 120 OHMS and are paired with a 120 OHMS resistor in a voltage divider circuit (fig. 1.1). This produces +5V at the mid-point which is matched with +5V from another voltage divider (two 1K OHM resistors) so giving 0V input to the differential amplifier. Even when the strain gauge resistance is not exactly 120 OHMS (so V is not exactly +5V) a 0V input can be achieved by adjusting the bridge balance pots (not shown) which simply change Va to equal V. With the bridge balanced any change in strain gauge resistance due to an applied strain (or temperature changes, leakage to ground, etc.) will produce a voltage Vin which will be amplified to give Vout. Resistance changes of ±0.48 OHMS will produce a full range amplifier card output of 0 to +10V. Plugging in the 30K calibration resistor changes the apparent resistance of the strain gauge by 0.48 OHMS and so simulates a full scale change. The actual strain required to produce this 0.48 OHMS change in strain gauge resistance depends on the gauge factor of each particular strain gauge (but is approximately 2000 micro strains).

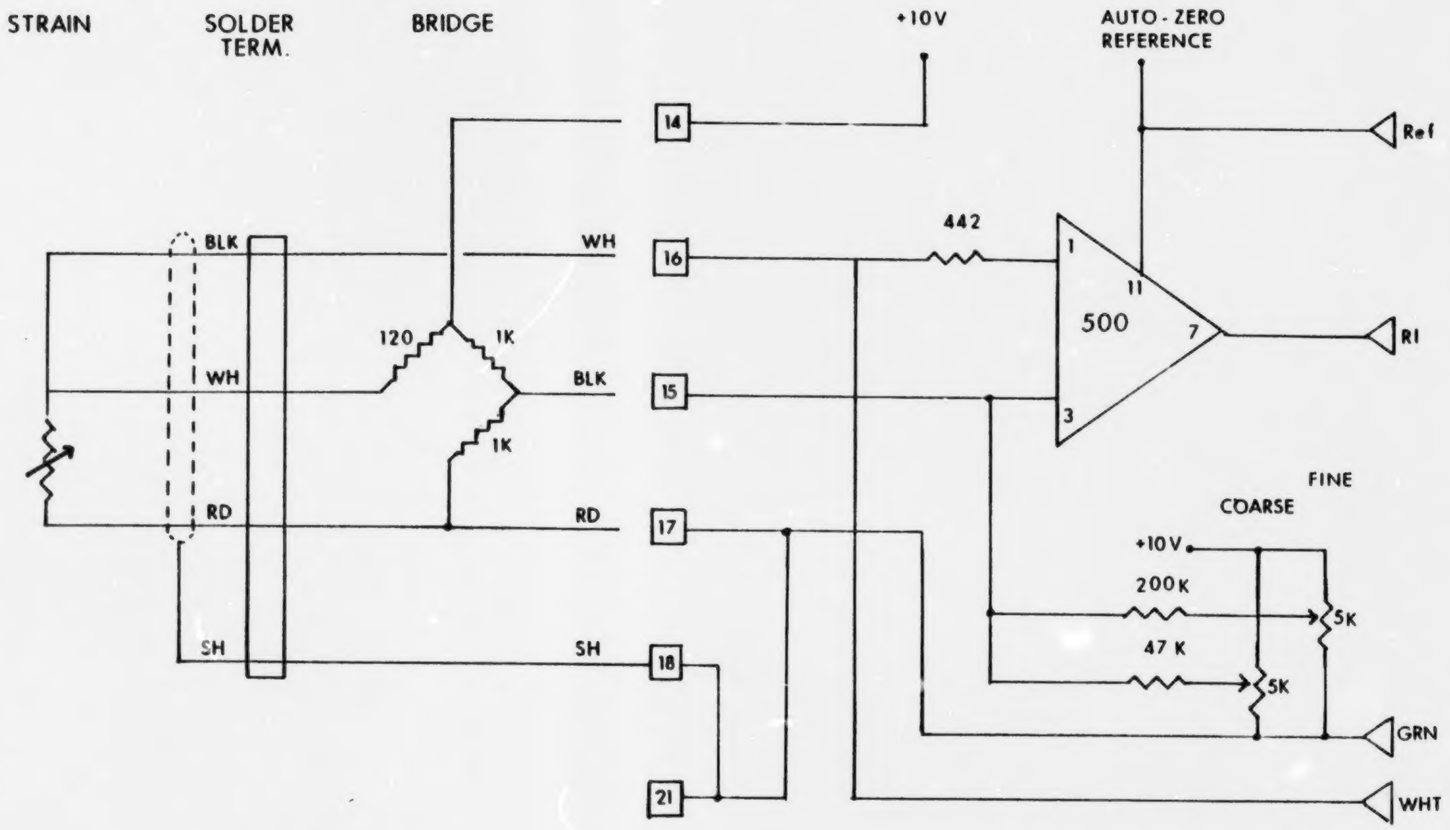

STRAIN
SOLDER TERM.
BRIDGE
+10V
AUTO-ZERO REFERENCE
14
16
15
17
18
21
BLK
WH
RD
SH
120
1K
1K
WH
BLK
RD
SH
442
1
11
500
7
3
Ref
RI
FINE
COARSE
+10V
200K
47 K
5K
5K
GRN
WHT

FIG. 1.1
STRAIN GAUGES

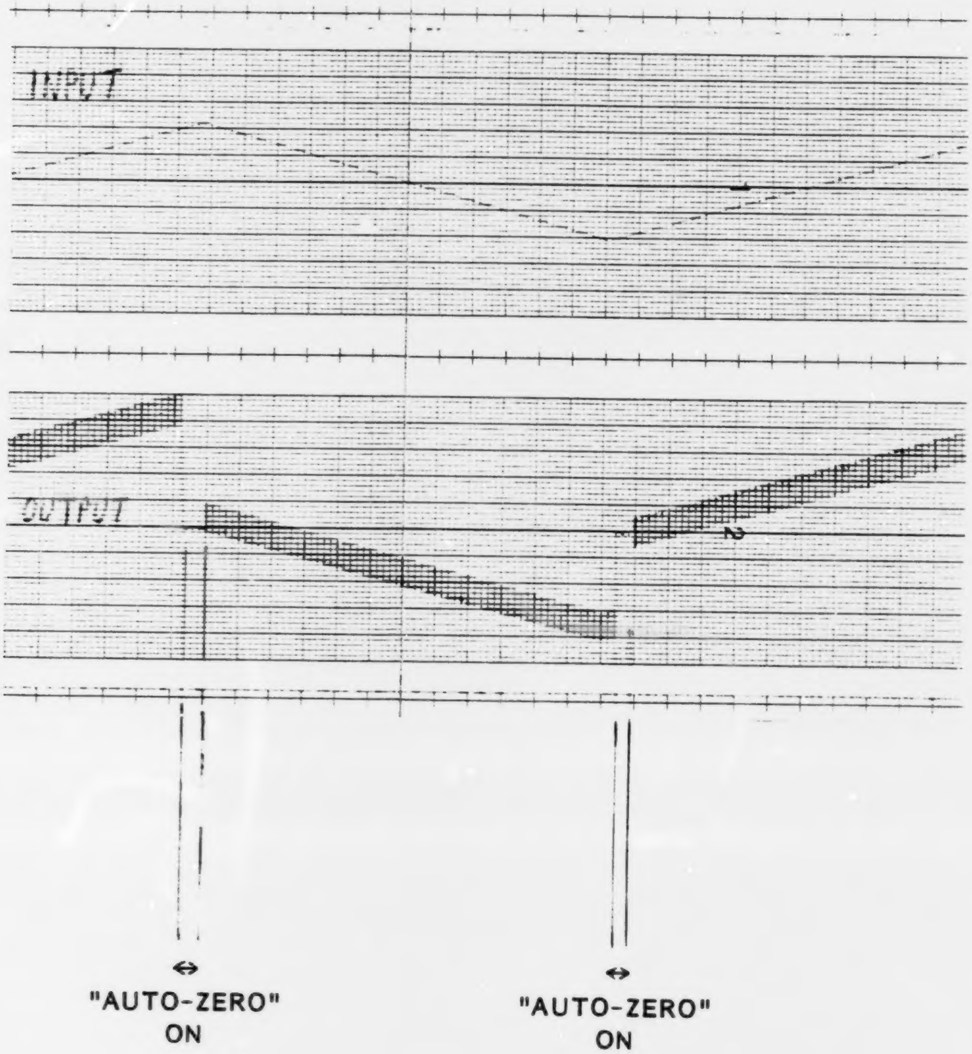
1.1.2 'Auto-Zero' circuitry is included in the strain gauge amplifier cards. The original purpose of this feature was to correct for any drift in the amplifier. To do this it switched off the 10V supply to the strain gauges. With no input voltage the amplifier should have an output of +5V. The actual output was compared with a +5V reference level and the amplifier reference voltage adjusted to produce an output of +5V. The 10V supply was then switched back on.

A later modification meant that the 10V supply remained on during the auto-zero cycle. The effect now is that whenever an auto-zero comand is received, the circuit brings the output to 0 S regardless of the actual strain affecting the strain gauge (fig. 1.2). The computer program is set to give auto-zero commands every minute. This would effectively hold all strain gauge outputs at 0 S except for short duration (less than 1 minute) ice impacts.

The auto-zero function could potentially be useful in counteracting small strain gauges drifts. However, it should be used sparingly, say once every day, certainly not once a minute. Also, it should never be used when an ice impact is likely.

Because the reference voltage is determiend by the number held in registers IC7 and 8 any power failure to the subjunction boxes results in uncertain reference voltages. To reset the reference voltage, push the 'Preset Auto Zero' push button on the master cards affected.

FIG. 1.2 Effect of the "Auto Zero" Function



1.1.3 The gauge factor is the proportionality constant relating the fractional change in length (strain) of the gauge to the fractional change in gauge resistance produced.

$$\varepsilon = \frac{\Delta L}{L} = \frac{1}{F} \times \frac{\Delta R}{R}$$

$\varepsilon$ = strain
$F$ = gauge factor

$$\therefore \quad \Delta R = F . R . \varepsilon$$

Four different gauge factors are found amongst the strain gauges installed, so the range of strain measurements is different in the four cases. To establish the range it is necessary to determine the strain that will produce a change in strain gauge resistance of 0.48 ohms. (The 30K ohm calibration resistor produces a full scale deflection in output by simulating a 0.48 ohm change in strain gauge resistance.)

for F = 1.96 $\Delta R$ = 0.48 is produced by = 2040 $\mu$S
for F = 1.90 " " " " = 2100 $\mu$S
for F = 1.83 " " " " = 2180 $\mu$S
for F = 1.77 " " " " = 2260 $\mu$S

### 1.1.4 Setting-up procedure

1. Place amplifier on extender card and insert into its proper card rack socket.

2. Turn "Box" power "On".

3. Adjust amplifier balance as follows:

   Connect DVM between "RL" and ground (eg. OV test point on M/C). Short inputs to amplifier, using a jumper across loops on board. Depress- and hold - "Preset Auto Zero" a switch on bin M/C. Adjust "Amp" trim pot for a +5.0V reading ± 3mV.

4. Adjust "Auto Zeroing"

   Leave DVM connected as above
   Depress - and hold - "Zero Check" switch only.
   Adjust "Level" trim pot for a +5.0V reading ± 1mV.

5. Adjust "Bridge Balance"

   Leave DVM connected as above, and remove jumper from amplifier input. Depress - and hold - "Preset Auto Zero" switch only.

   (If "Auto Zero" is switched off at the computer interface, it is only necessary to depress and release the "Preset Auto Zero" switch in order to reset the reference voltage to its nominal value).

   Adjust "Coarse" and "Fine" balance, ie: "C BAL" and "F BAL" - to set output at "RL" to 5.0V ± 5mV.

6. Adjust Gain

Insert 30K OHM test resistor between "CAL" and "GND".

Adjust "Gain" trim potential so that output at "RL" is 0.00 Volts.

### 1.1.5 Short Set-up Procedure

The amplifier balance, gain and level settings should only need adjusting at the beginning of each operational season. The bridge balance, however, will go out more quickly because of impacts producing dents (permanent strains) and strain gauge drift. Therefore, section 5 should be repeated at regular intervals.

### 1.1.6 Low Pass Filters

14 filter cards having two separate filters are available for use with the strain gauge amplifiers. Filter 1 uses a 1 micro F and 10K OHM RC network to give a corner frequency of 25Hz, while filter 2 uses a 0.22 micro F and 10K OHM RC network to give a corner frequency of 125 Hz (Fig. 1.3). To use a filter card with one of the strain gauge channels, plug the filter card into a spare socket in the same box and connect the wander lead from the filter card to the REAL test point of the required amplifier card. To record the filter output, address the channel used by the filter card. However, this channel number is in no way related to the strain gauge providing the input, through its amplier, to the filter so it is necessary to keep a separate log of which filter card is used with which amplifier card. Filter card output A (Real) comes from filter 1 and should be used with a sampling rate of 100 samples/sec., while output B (peak) from filter 2 is for use with sampling rates of 500 or 1000 samples/sec.

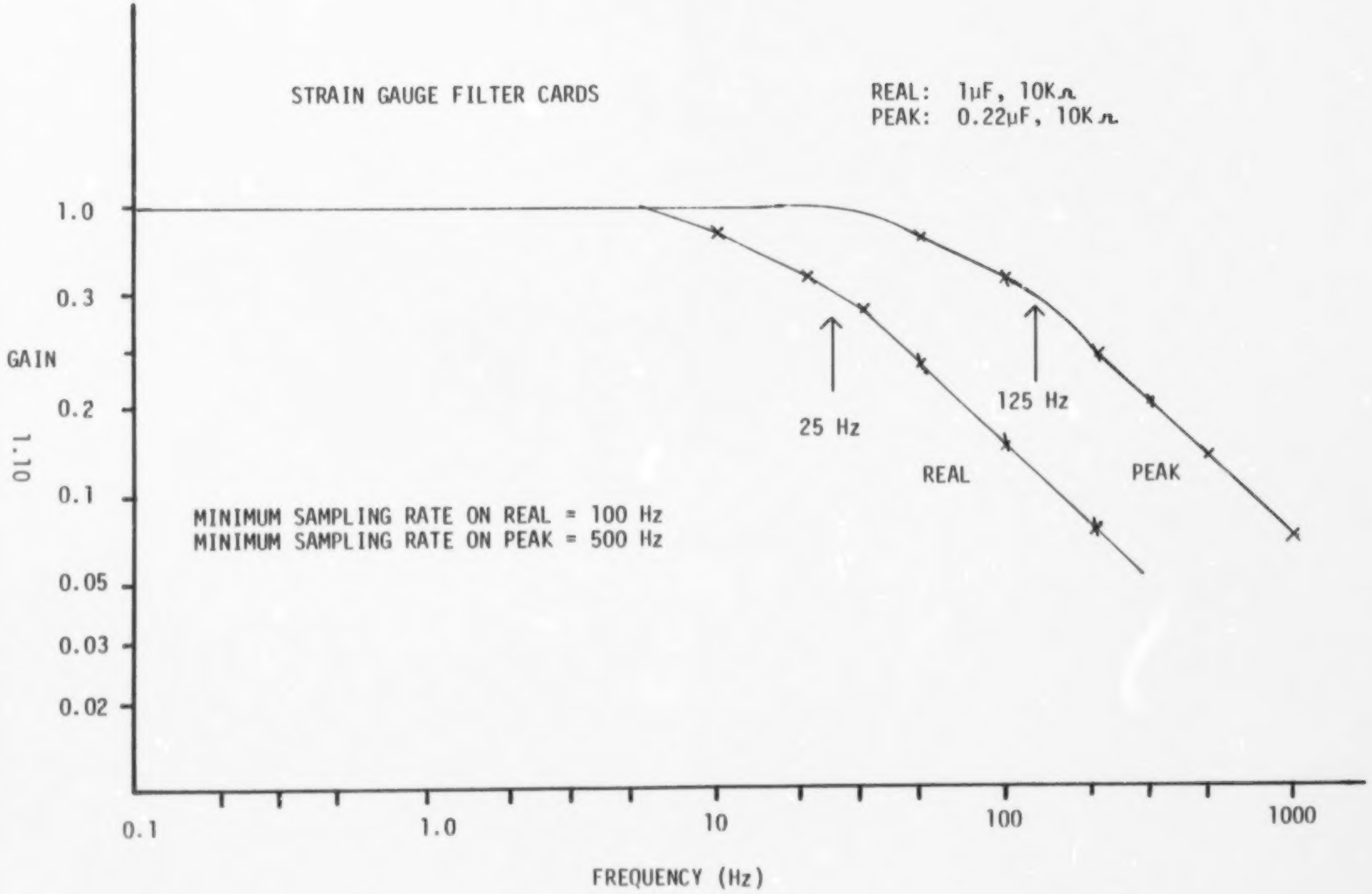
STRAIN GAUGE FILTER CARDS
REAL:  1μF, 10KΩ
PEAK:  0.22μF, 10KΩ
1.0
0.3
GAIN
0.2
0.1
0.05
0.03
0.02
25 Hz
125 Hz
REAL
PEAK
MINIMUM SAMPLING RATE ON REAL = 100 Hz
MINIMUM SAMPLING RATE ON PEAK = 500 Hz
0.1
1.0
10
100
1000
FREQUENCY (Hz)

FIGURE 1.3

## 1.1.7 Location of Strain Gauges (as originally installed) Fig. 1.4 & 1.5

**Starboard Bow**

| | | |
|---|---|---|
| Main Frames<br>Intermediate Frames | Angle | 90 |
| Outer Plates | | 38 |
| Web Frame #182 | | 4 |
| Stringer #5 | | 4 |
| Inner Skin Plates | | 4 |
| | | 140 |

**Port Bow**

| | | |
|---|---|---|
| Main Frames<br>Intermediate Frames | Angle | 10 |
| Outer Plates | | 10 |
| | | 20 |

**Mid-section**

| | | |
|---|---|---|
| Plates<br>Frames | | 10 |
| | Total | 170 |

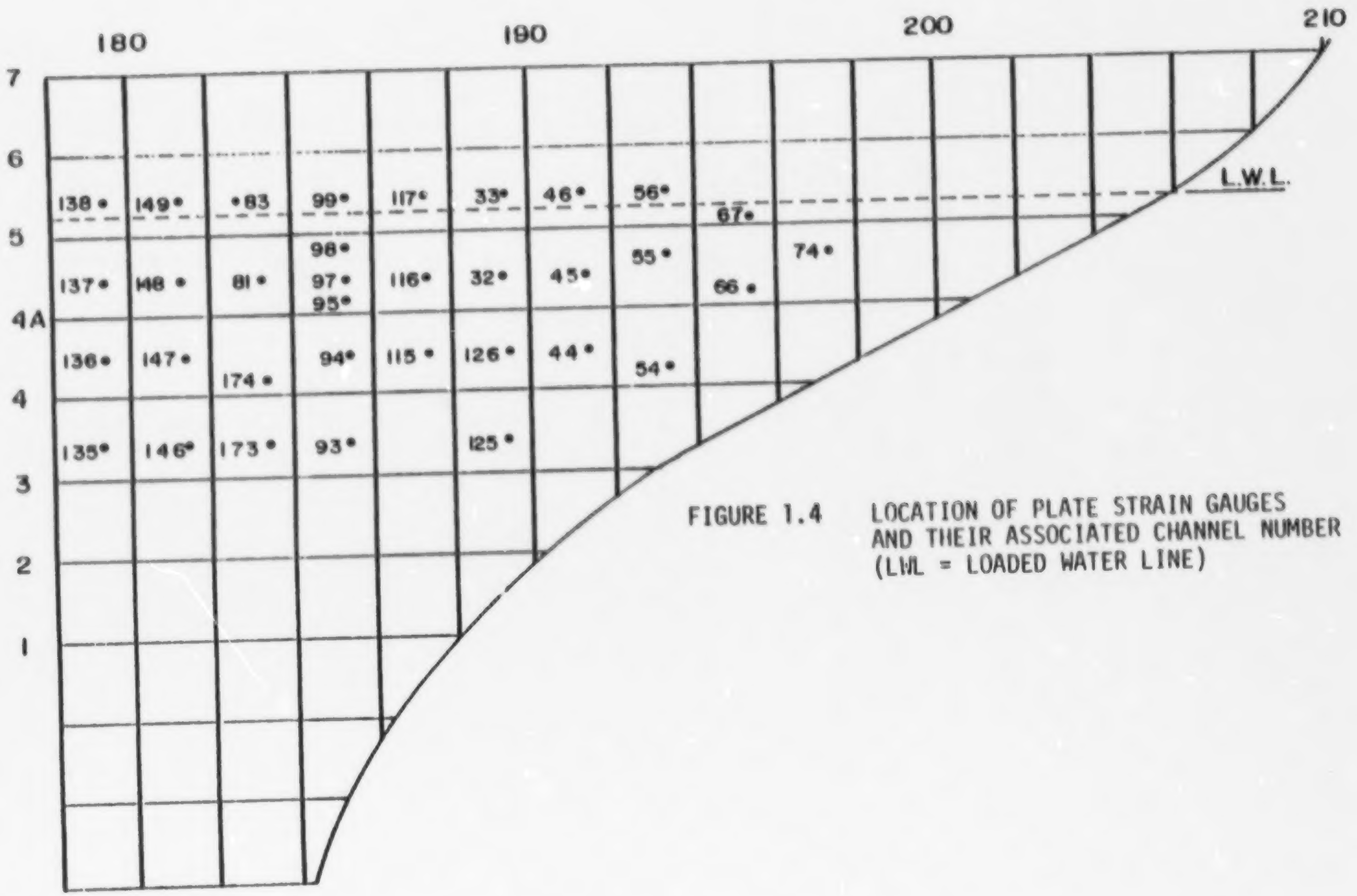

180
190
200
210
7
6
5
4A
4
3
2
1
L.W.L.
138
149
83
99
117
33
46
56
67
137
148
81
98
97
95
116
32
45
55
66
74
136
147
174
94
115
126
44
54
135
146
173
93
125

FIGURE 1.4 LOCATION OF PLATE STRAIN GAUGES AND THEIR ASSOCIATED CHANNEL NUMBER (LWL = LOADED WATER LINE)

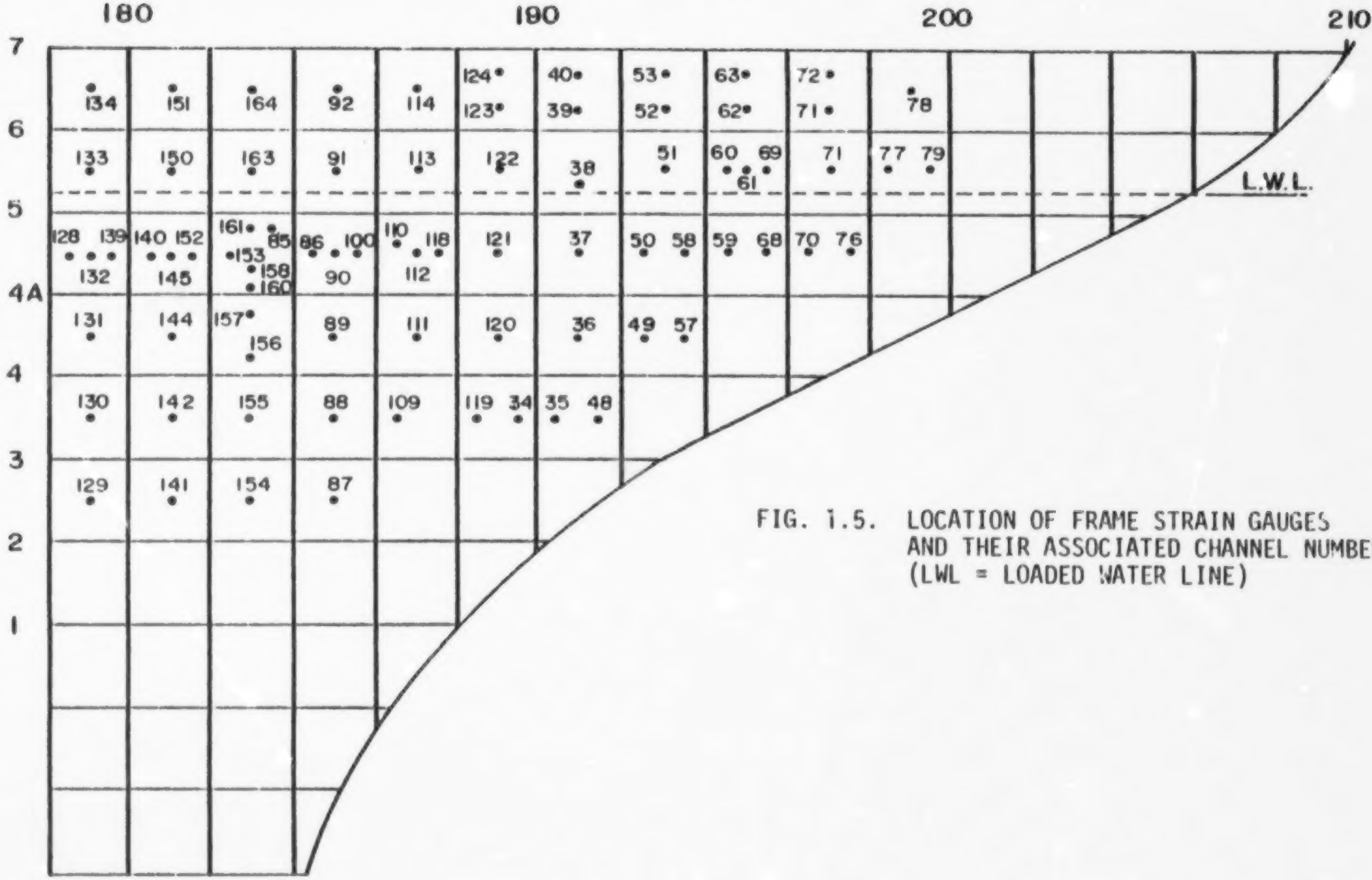

180
190
200
210
7
6
5
4A
4
3
2
1
L.W.L.
134
151
164
92
114
124
123
40
39
53
52
63
62
72
71
78
133
150
163
91
113
122
38
51
60
69
61
71
77
79
128
139
132
140
152
145
161
85
153
158
160
86
100
90
110
118
112
121
37
50
58
59
68
70
76
131
144
157
156
89
111
120
36
49
57
130
142
155
88
109
119
34
35
48
129
141
154
87

FIG. 1.5. LOCATION OF FRAME STRAIN GAUGES AND THEIR ASSOCIATED CHANNEL NUMBER (LWL = LOADED WATER LINE)

## Strain Gauge Reference Number

xxx.x / xxx

/ \

Frame Designator Location

### a) Frame Designator

xxx = Frame Number

.x = .5 for half frames

= .0 for full frames

ie. 192.0 = Frame (main) 192

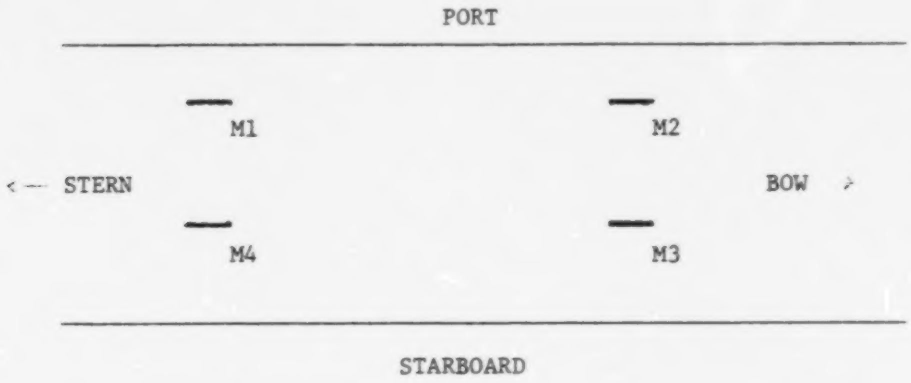
192.5 = Intermediate frame fwd. of frame 192.0 and aft. of frame 193.0

### b) Location

001-099: Frame Stbd.
100-120: Frame Port.
121-170: Plate Stbd.
171-190: Plate Port.
191-200: Stringer
201-210: Inner Skin
211-220: Mid-Section

### 1.1.8 Mid-section Strain Gauges

Four strain gauges have been fixed to the underside of longitudinal beams in the bubbler compartment to measure strains produced by flexing of the ship. These gauges are connected to amplifier cards in box 5.



M1: S/G 129-11-150-6S
Gauge Factor: 1.83
Resistance: 121.0 ohm
Connected to channel 178

M2: S/G 129-11-150-6S
Gauge Factor: 1.83
Resistance: 120.5 ohm
Connected to channel 177

M3: S/G 129-11-100-6S
Gauge Factor: 1.83
Resistance: 120.5 ohm
Connected to channel 176

M4: S/G 129-11-150-6S
Gauge Factor: 1.83
Resistance: 119.8 ohm
Connected to channel 179

(Installed October 1980 by M. Michailides, NRC)

## 1.2 Thermistors

Installation of four thermistors, Fenwal Electric type GB32P2 was made in proximity to frame 193, on shell plates, as shown in figure 1.6.

Thermistor outputs were routed to Box I, Bin 0 and connected into channels as follows:

Thermistor #1000 to channel #5
Thermistor #2222 to channel #6
Thermistor #3333 to channel #7
Thermistor #4444 to channel #8

The thermistor resistance decreases as temperature increases so producing an inverse relationship between temperature and the amplifier output voltage.

### 1.2.1 Circuit Details

The thermistor is paired with a 10K resistor (mounted on the amplifier card) to form a voltage divider (fig. 1.7). Changes in thermistor resistance thus produce in input voltage to the amplifier which has a gain of 1 and a reference of 0V, so produces an indentical change in the output voltage.

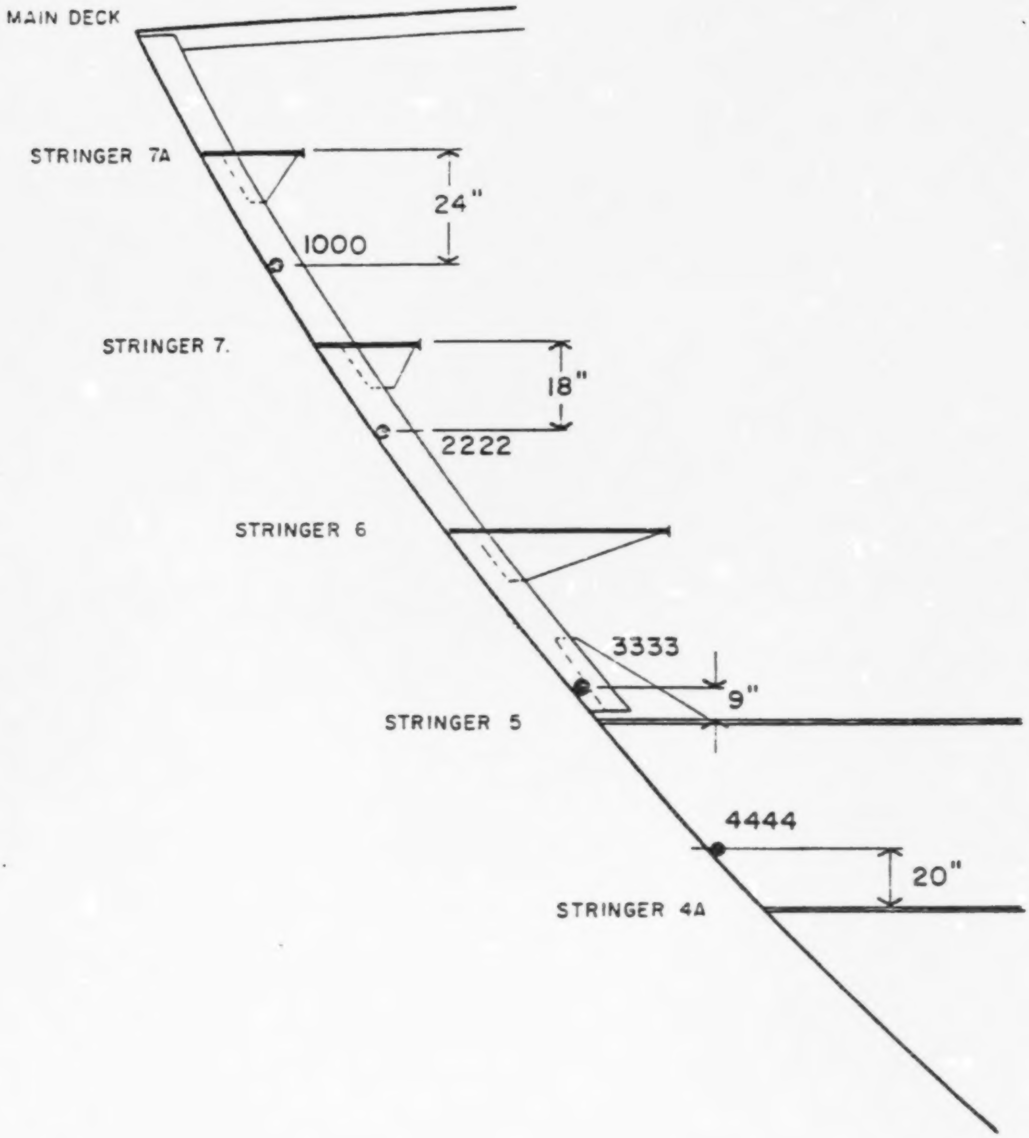

MAIN DECK
STRINGER 7A
24"
1000
STRINGER 7.
18"
2222
STRINGER 6
3333
9"
STRINGER 5
4444
20"
STRINGER 4A

FIGURE 1.6 LOCATION OF THERMISTORS AT FR. 193 STARBOARD SIDE.

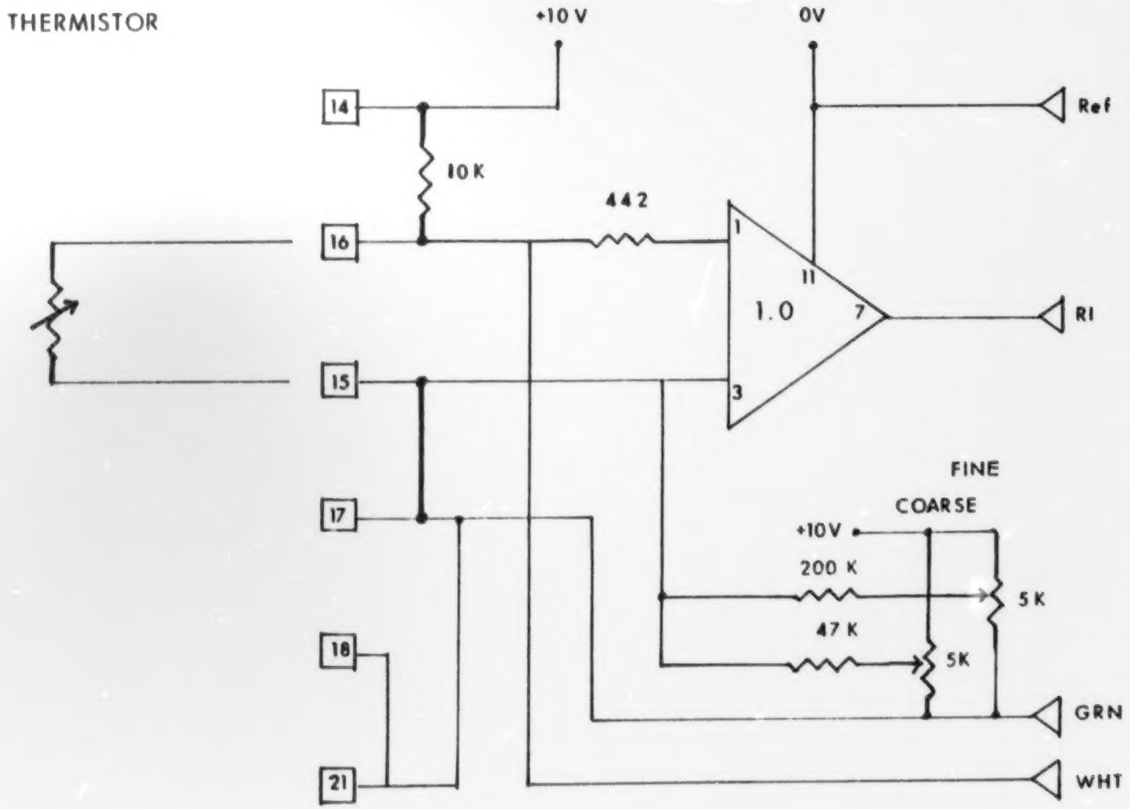

THERMISTOR
+10 V
0V
14
10K
442
16
15
17
18
21
1
11
1.0
7
3
Ref
RI
FINE
COARSE
+10V
200 K
47 K
5K
5K
GRN
WHT

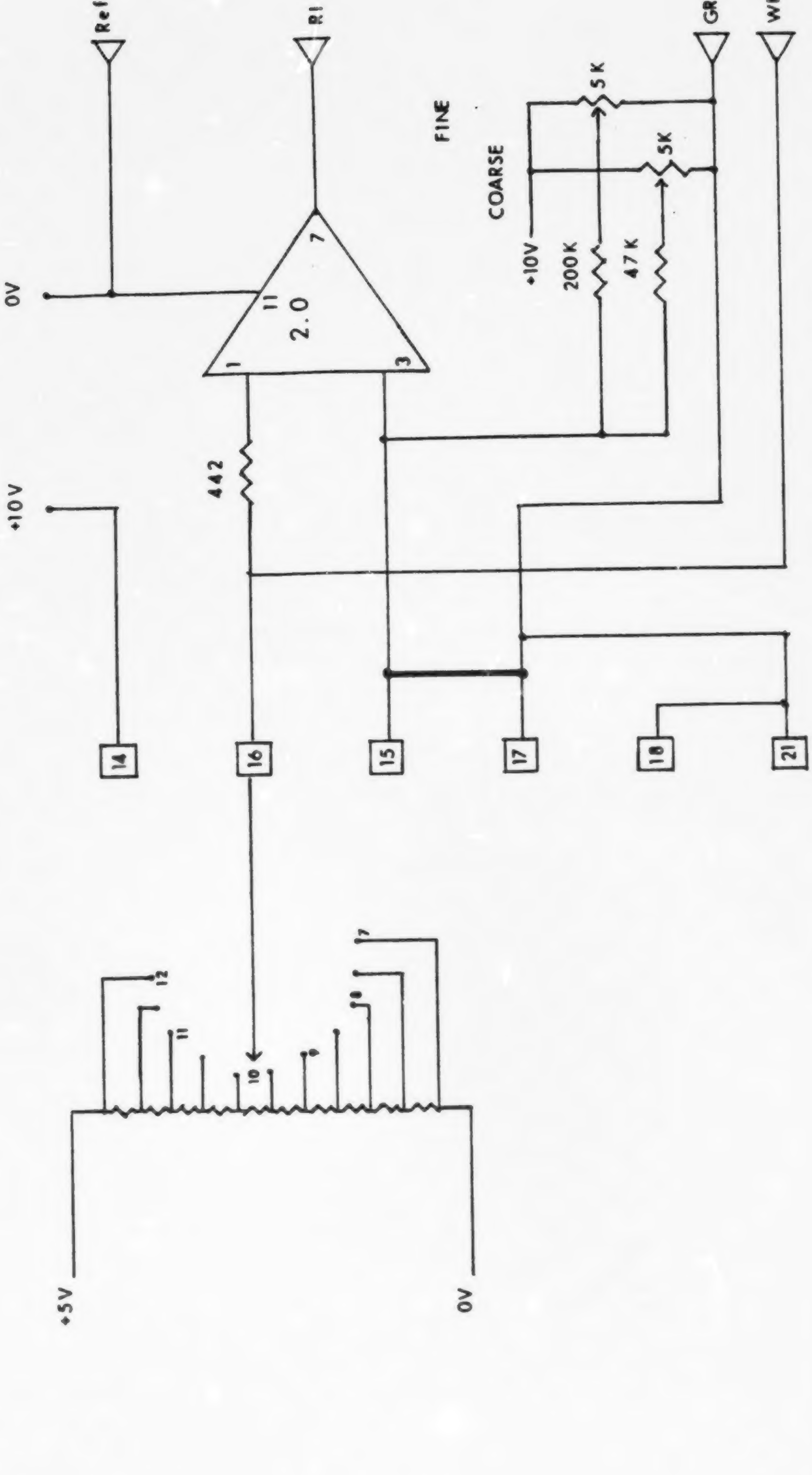
FIGURE 1.7 THERMISTORS

## 1.3 Ships Draft (Fig. 1.8)

Both fore and aft ships draft can be entered manually through separate switches mounted in the navigation console in the pilot house.

These are step switches calibrated in metres - see Figure and provide variable 0-5 volt inputs into separate channel amplifiers.

Channel 252 provides forward draft output and channel 253 is the after draft. Both channels are in Box #7.



Ref
R1
0V
+10V
11
2.0
1
3
7
442
FINE
COARSE
+10V
200K
47K
5K
5K
GRN
WHT
14
16
15
17
18
21
+5V
0V
12
11
10
9
8
7

Figure 1.8 DRAFT

# SECTION 2

# SHIP PERFORMANCE INSTRUMENTATION

# Section 2: Ship Performance Instrumentation

- 2.1 Ship Speed
    - 2.1.1 Doppler Log
    - 2.1.2 Interface Unit
    - 2.1.3 Circuit Details
- 2.2 Ship's Head
    - 2.2.1 Gyrocompass Potentiometer
    - 2.2.2 Circuit Details
- 2.3 Pitch and Roll
    - 2.3.1 Circuit Details
    - 2.3.2 Gyro
- 2.4 Accelerometers
    - 2.4.1 Circuit Details
    - 2.4.2 Calibration Procedure
    - 2.4.3 Low Pass Filters

## 2.1 Ship Speed

The ship is fitted with a Sperry SRD 301 Doppler Speed Log which provides a digital readout on the bridge of the ship's speed. The digital signal at the display is tapped off to a D/A converter which is connected to the amplifier card in box 7, channel 236.

### 2.1.1 Doppler Log

There is a separate manual for the doppler log but the general layout will be explained here. The doppler log consists of four units: a transducer, located under No. 1 Port double-bottom tank directly under the forward manhole access in hold No. 1; a transceiver unit, situated next to the phone in the forepeak; an electronics unit, mounted on the rear wall of the bridge; and the master display unit on the bridge console.

Ship's speed is measured by transmitting pulsed sonic energy into the water and detecting the doppler shift of the reflected signals. The measurements are averaged over a 14 sec. period and the display updated at the end of this time. Speed information is available from a 16 bit shift register that stores 12 bits of speed data, 2 bits of operating data, and 2 unused bits. This information can be transmitted in serial data form using SHIFT CLOCK pulses also supplied.

### 2.1.2 Interface Unit

This is located under the bridge console. A grey cable leads from the Doppler Log master display unit and a black cable goes to Box 7, channel 236. The interface circuit is shown in fig. 2.1.

Data is clocked out of the speed log by SHIFT CLOCK pulses into a serial-in parallel-out shift register. The device is presently wired to shift data on the high to low transition of the SHIFT CLOCK pulses. If the low to high transition is needed instead, rotate dip plug with jumper by 180° (located adjacent to 74LS14 chip). The stored data is decoded, afterwards, by a BCD D/A converter DAC-80 CCD-V. Analogue output of 0.00V represents an input of 00.0 knots, while an output of +2.96V represents an input of 29.6 knots (the log test setting). The interface unit does not distinguish between speeds ahead and astern.

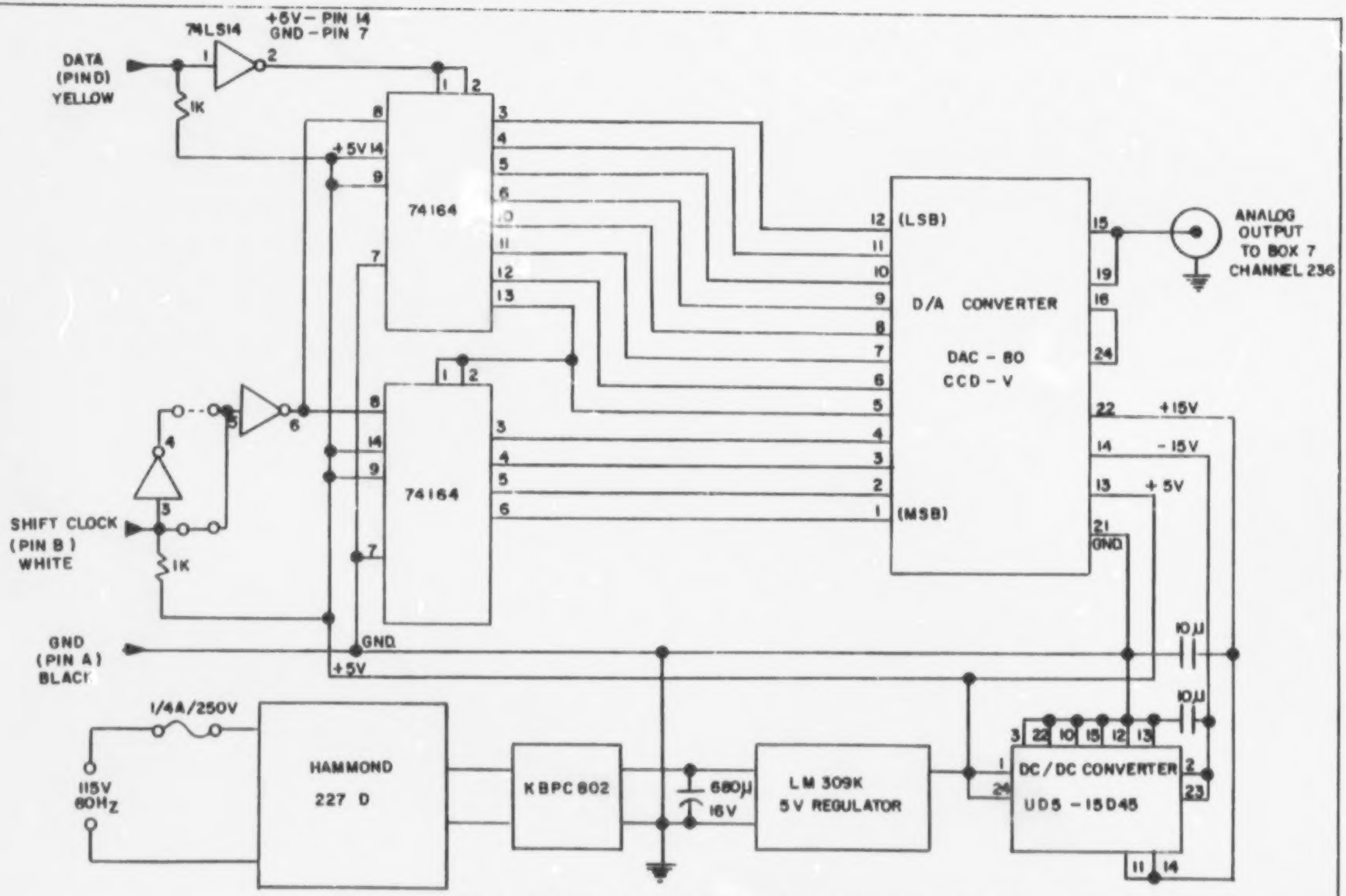

74LS14
+5V - PIN 14
GND - PIN 7
DATA
(PIND)
YELLOW
1K
74164
74164
+5V 14
SHIFT CLOCK
(PIN B)
WHITE
1K
GND
(PIN A)
BLACK
GND
+5V
(LSB)
(MSB)
D/A CONVERTER
DAC - 80
CCD - V
ANALOG
OUTPUT
TO BOX 7
CHANNEL 236
+15V
-15V
+5V
GND
10µ
10µ
1/4A/250V
115V
60Hz
HAMMOND
227 D
KBPC 602
680µ
16V
LM 309K
5 V REGULATOR
DC/DC CONVERTER
UD5 - 15D45

FIGURE 2.1 LOGIC DIAGRAM, DIGITAL TO ANALOG CONVERTOR, DOPPLER SPEED LOG.

8/1979

3501-505

### 2.1.3 Amplifier Circuit Details

The amplifier has a gain of 3.3 and Vref = 0V (fig. 2.2). The 0 to +10V output range thus theoretically corresponds to a speed range of 0 to 30 knots, although in practice only speeds up to 18 knots will be encountered.

Note: Ship Wiring Diagram (No. M 160) for Doppler Log is held by the Chief Engineer.

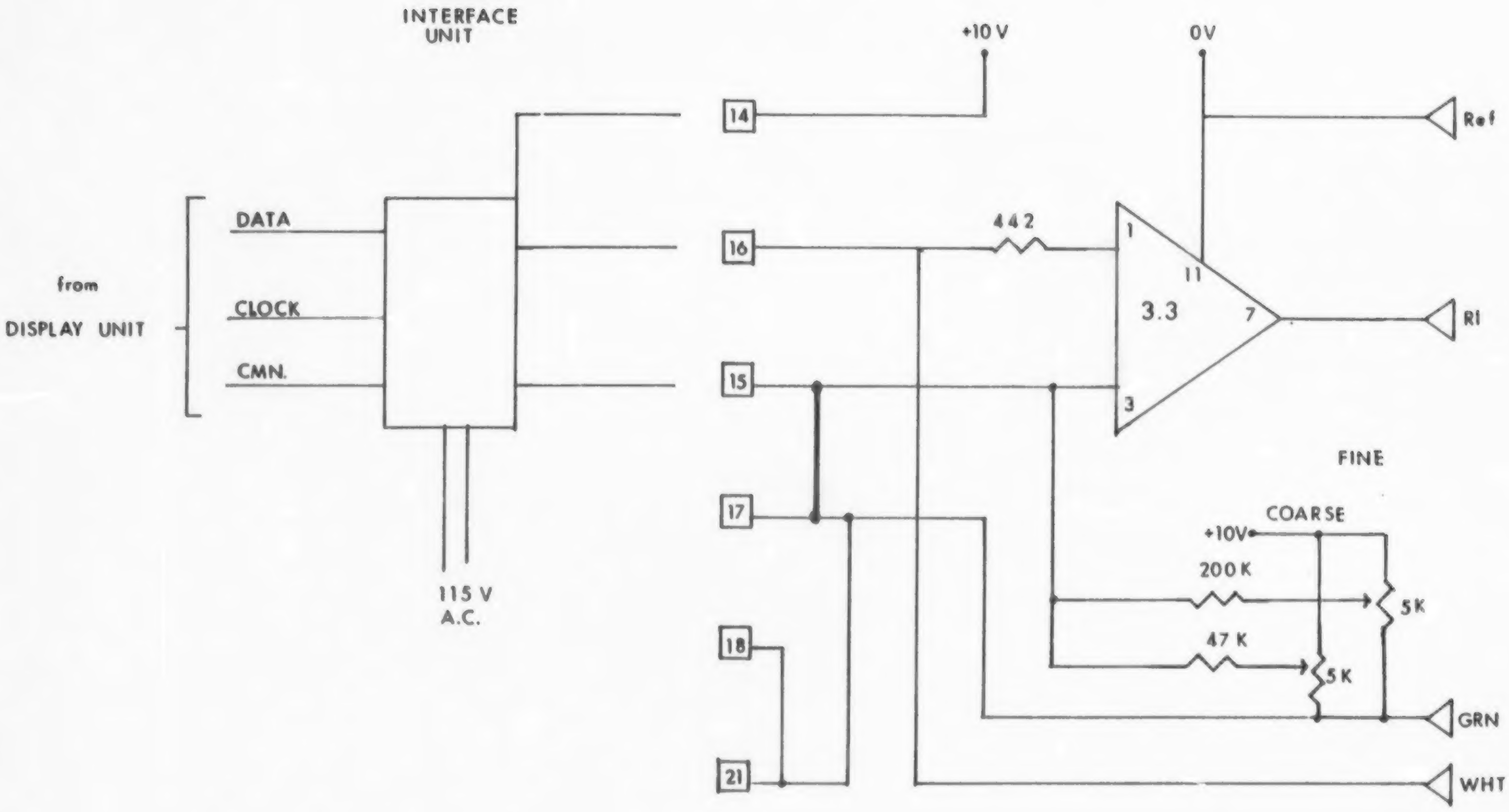

INTERFACE UNIT
+10 V
0V
from DISPLAY UNIT
DATA
CLOCK
CMN.
115 V A.C.
14
16
15
17
18
21
442
1
11
3.3
7
3
Ref
RI
FINE
COARSE
+10V
200 K
47 K
5 K
5 K
GRN
WHT

FIG. 2.2
**SHIP SPEED**

## 2.2 Ship's Head (Sine/Cosine)

Two Sperry MR37 Mod 0 Gyrocompass units are fitted on the bridge. The No. 2 unit has been modified with a sine/cosine potentiometer and is connected to Box 7, channels 237 and 238. The latter gyro is located under the chart table on the port side of the bridge, and is connected to a control unit in a cupboard accessed from firward side of the chart table. The output terminals of sine/cosine signal from the control unit are connected to a terminal strip under the bridge console and from there to Box 7, channels 237 and 238 (fig 2.3). Details concerning the gyrocompass, such as the start-up procedure, are contained in the Sperry manuals kept on the bridge.

### 2.2.1 Gyrocompass Potentiometer

Gyrocompass Mk27 Mod 1 has been factory modified by adding a sine/cosine potentiometer (R2) to the compass element assembly. Outputs from the potentiometer are voltages proportional to the sine and cosine of the compass heading (azimuth) angle. Excitation to the potentiometer (+ and -E) must be provided from the equipment using the potentiometer outputs. The potentiometer dissipation rating is two watts, and an excitation level of less than ± 28 volts d.c. is recommended.

Potentiometer outputs are as follows (refer to fig. 2.4):

$$V_{2-7} = E \sin\theta$$

$$V_{4-5} = E \cos\theta$$

where $\theta$ = heading angle

$E$ = excitation applied across the winding between terminals 1(+) and 3(-)

## POTENTIOMETER WIRING DIAGRAM

## SPERRY Mk 37 GYROCOMPASS

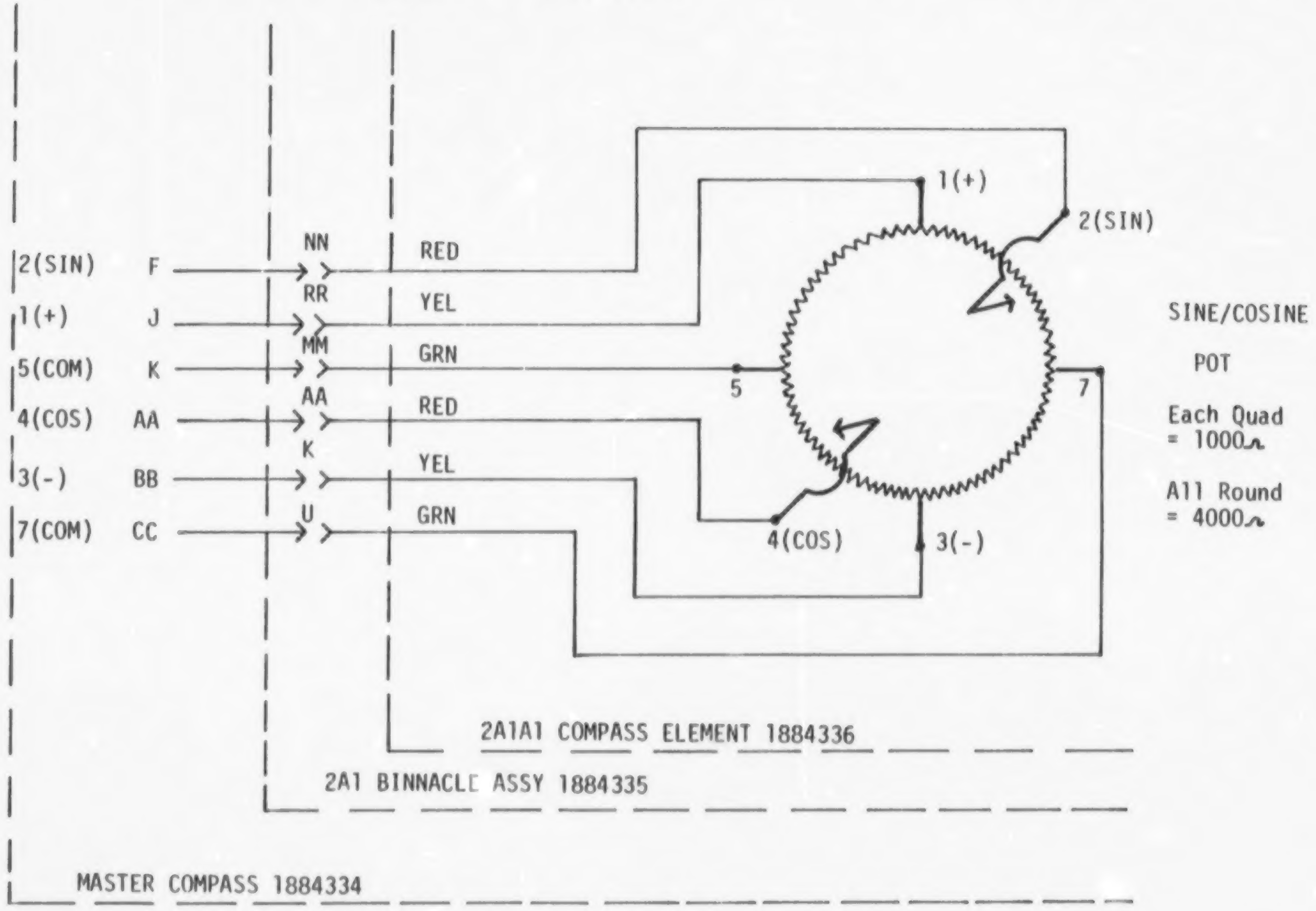
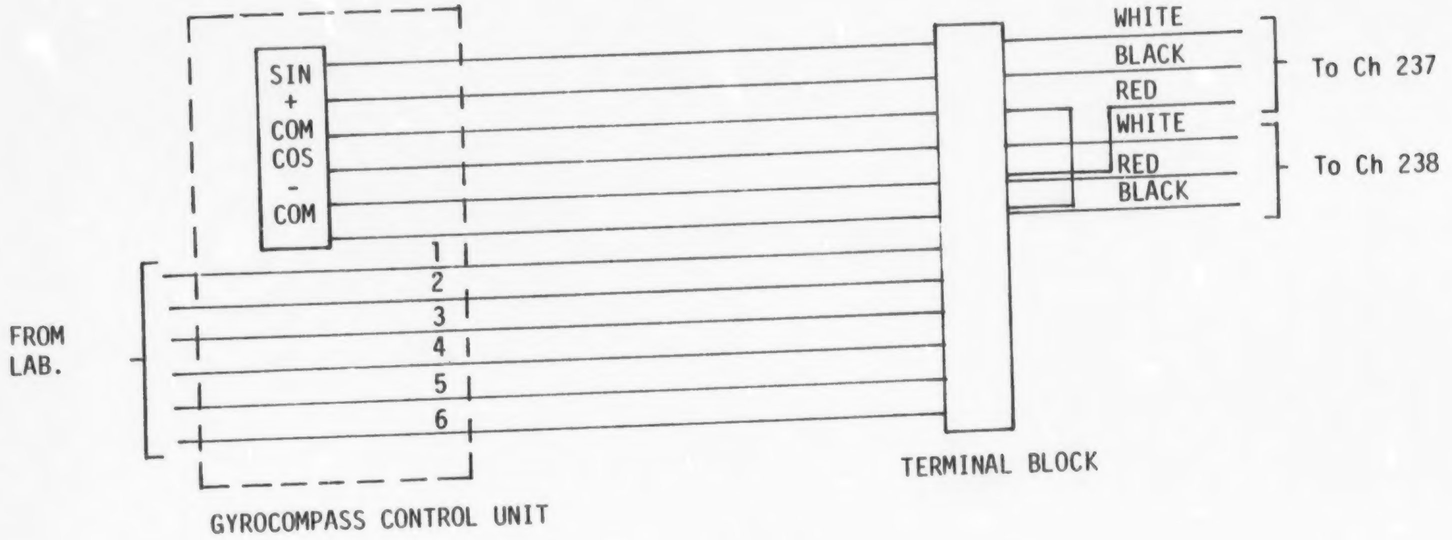

2(SIN)
1(+)
5(COM)
4(COS)
3(-)
7(COM)
F
J
K
AA
BB
CC
NN
RR
MM
AA
K
U
RED
YEL
GRN
RED
YEL
GRN
1(+)
2(SIN)
5
7
4(COS)
3(-)
SINE/COSINE
POT
Each Quad
= 1000Ω
All Round
= 4000Ω
2A1A1 COMPASS ELEMENT 1884336
2A1 BINNACLE ASSY 1884335
MASTER COMPASS 1884334

FIG. 2.3


SIN
+
COM
COS
-
COM
1
2
3
4
5
6
FROM LAB.
GYROCOMPASS CONTROL UNIT
TERMINAL BLOCK
WHITE
BLACK
RED
WHITE
RED
BLACK
To Ch 237
To Ch 238

NOTE: CONDUCTORS 1 TO 6 RELATE TO PITCH AND ROLL GYRO.
GYRO COMPASS CONTROL UNIT CHOSEN AS CONVENIENT
LOCATION FOR SPLICE BETWEEN LABORATORY AND BOX NO. 7.

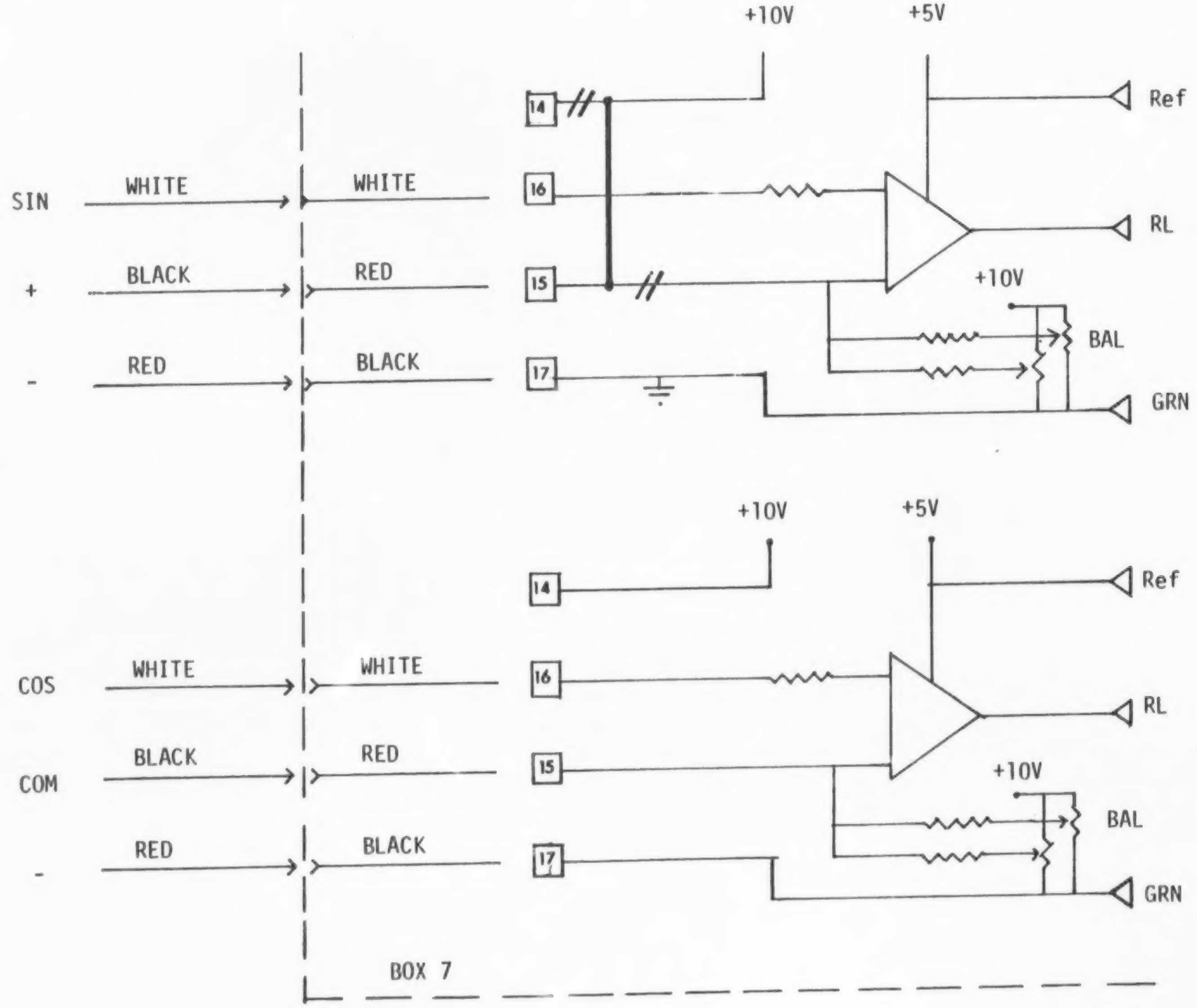
CONNECTIONS: GYROCOMPASS CONTROL UNIT TO BOX 7.

FIG. 2.4

### 2.2.2 Circuit Details

To obtain any information both amplifier cards 237 and 238 must be in place and working correctly. The cards are not interchangeable. Instead of using a potentiometer excitation of +E, 0, and -E, the applied voltages are +10V, +5V, and 0V. The +10V is supplied from the voltage regulator on card 237, while the +5V comes from the balance pots on card 238 (fig. 2.5). Both amplifiers have a gain of 1, a reference voltage of +5V, and use a differential input with one side connected to +5V from the balance pots. This arrangement passes the +5V ± 5V signal from the gyrocompass potentiometer through unchanged.

| Heading | Sine | Cosine | Ch 237 | Ch 238 |
|---|---|---|---|---|
| 0° | 0.0 | 1.0 | +5V | +10V |
| 90° | 1.0 | 0.0 | +10V | +5V |
| 180° | 0.0 | -1.0 | +5V | 0V |
| 270° | -1.0 | 0.0 | 0V | +5V |



+10V
+5V
14
Ref
SIN
WHITE
WHITE
16
RL
+
BLACK
RED
15
+10V
BAL
-
RED
BLACK
17
GRN
+10V
+5V
14
Ref
COS
WHITE
WHITE
16
RL
COM
BLACK
RED
15
+10V
BAL
-
RED
BLACK
17
GRN
BOX 7

FIG. 2.5

SHIP HEAD - SINE AND COSINE

## 2.3 Pitch and Roll

A Minneapolis Honeywell Vertical Gyro is located in the laboratory together with its associated power supplies. Pitch and Roll of the ship moves the wipers of two potentiometers which are connected to channels 237 and 238 of Box 7 on the bridge. Power for each potentiometer comes from its respective amplifier card. The gryo is aligned across instead of along the ship. Therefore, the potentiometer labelled 'pitch' on the gyro is used for measuring roll (Ch. 238); and the potentiometer labelled 'roll' on the gyro is used for measuring pitch (Ch 237). The connections, and operation, of the circuit can easily be checked by removing the mounting screws and tilting the gyro while monitoring each channel.

### 2.3.1 Circuit Details

The potentiometer is connected between two 440Ω resistors in a resistor chain across the 0 to +10V supply on each card. The resistors were (presumably) added to protect the supply against shorts in the cable run to the gyro potentiometer in the lab. A consequence of this arrangement is that the limit positions of the potentiometer give a signal of +0.5V and +9.5V. For zero roll and pitch the potentiometer outputs should be +5.0V. The amplifier uses a differential input so any offset can be negated by using the balance pots (fig. 2.6). The amplifier has a gain of 10 so produces a 0V, +5V, or +10V output for a pitch or roll of -5°, 0°, +5°. Positive for pitch means bow up, and for roll means roll to port.

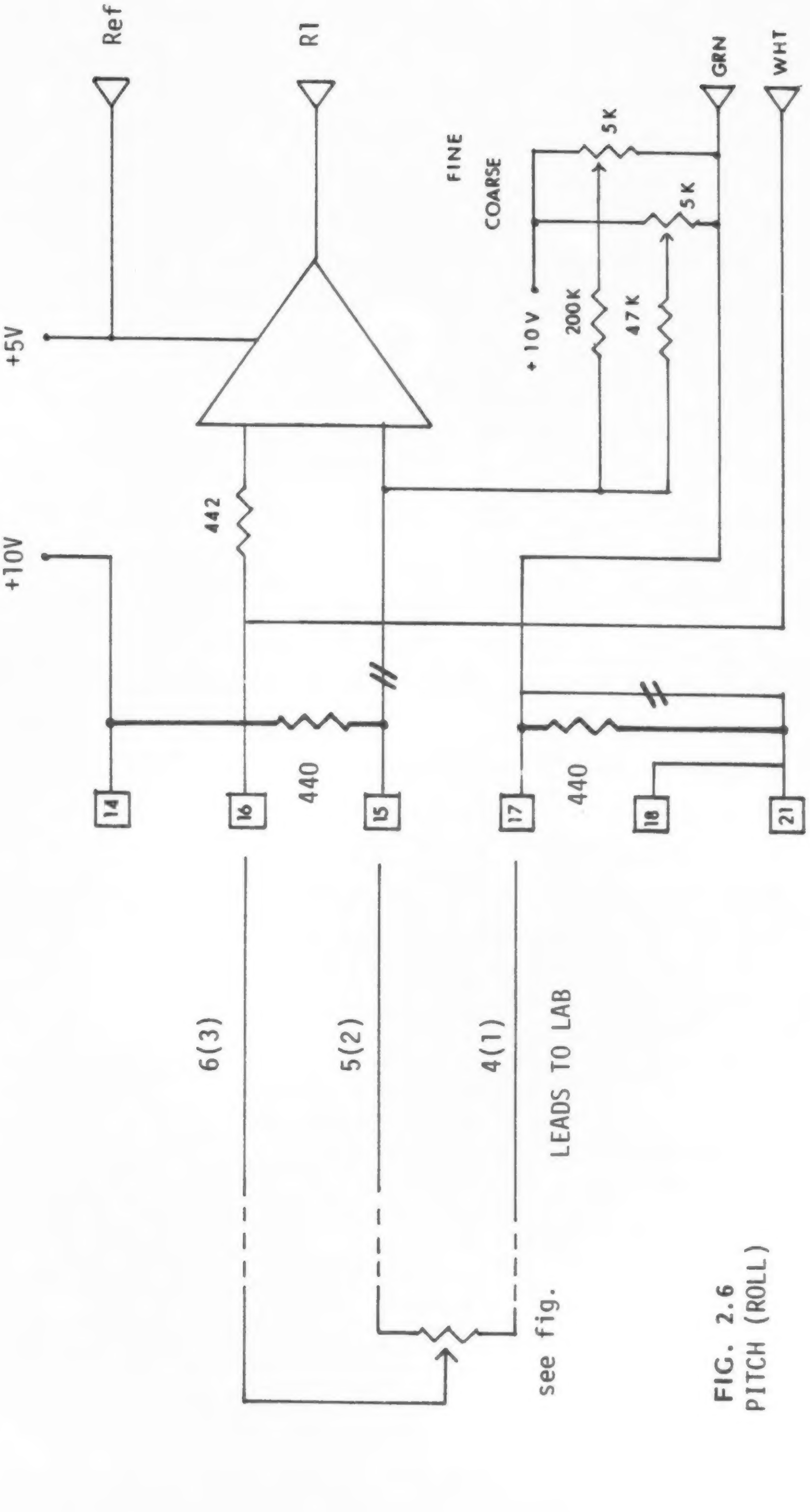

Ref
R1
GRN
WHT
+5V
FINE
COARSE
5K
5K
+10V
200K
47K
442
+10V
14
16
440
15
17
440
18
21
6(3)
5(2)
4(1)
LEADS TO LAB
see fig.

FIG. 2.6
PITCH (ROLL)

### 2.3.2 Vertical Gyro

The primary power for the high speed rotor is 115V 400Hz single phase, which necessitates the use of a frequency convertor, Behlman Model 161. The 28V AC Erection voltage is obtained through a transformer from the frequency convertor output. Power required for uncaging is 12V dc obtained from a ±12V transformer and a full wave rectifier. Connections to the gyro are shown in fig. 2.7 and 2.8.

The start up procedure for the gyro is:

1. Switch Convertor 'Line" ON - and wait for voltage to come up to 110V.
2. Switch Convertor 'Output' ON and wait several minutes until the hum of the gyro reaches constant tone.
3. Switch 'Cage/Uncage' to UNCAGE.
4. Switch "Erect" ON.

To shut down gyro, reverse the above sequence.

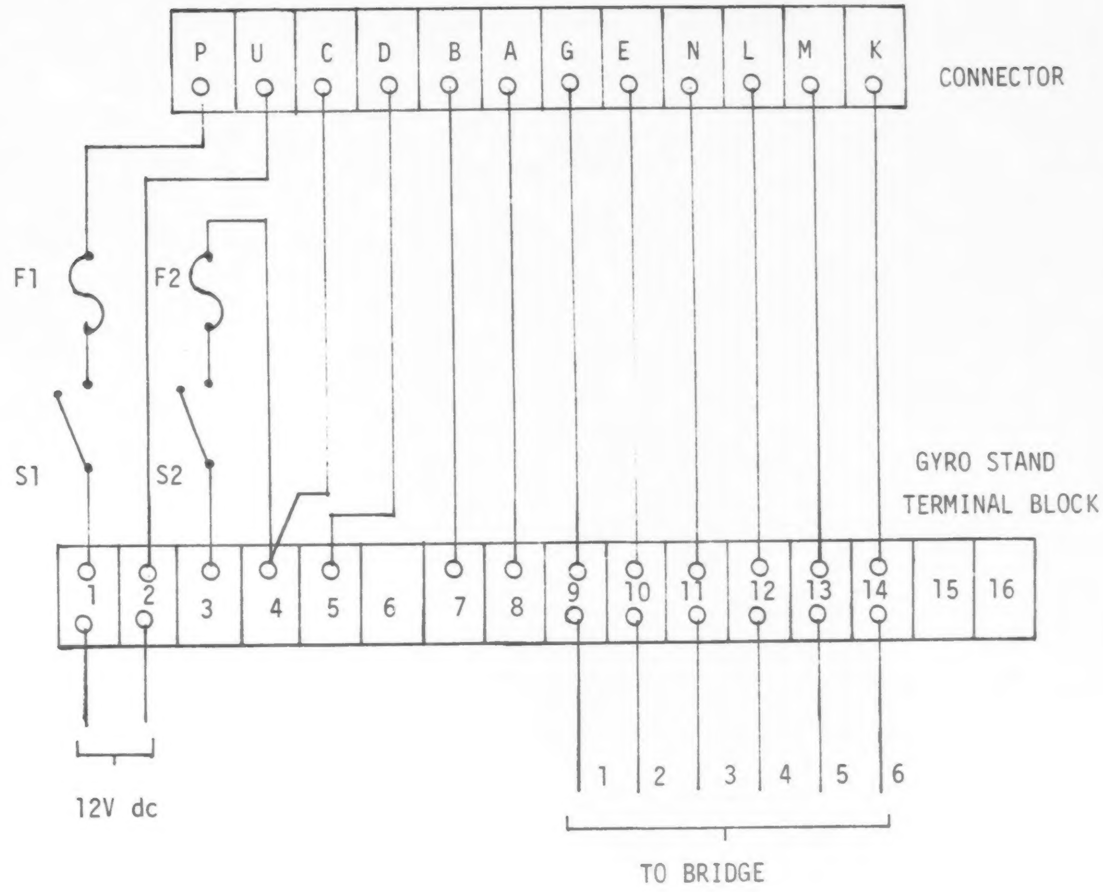
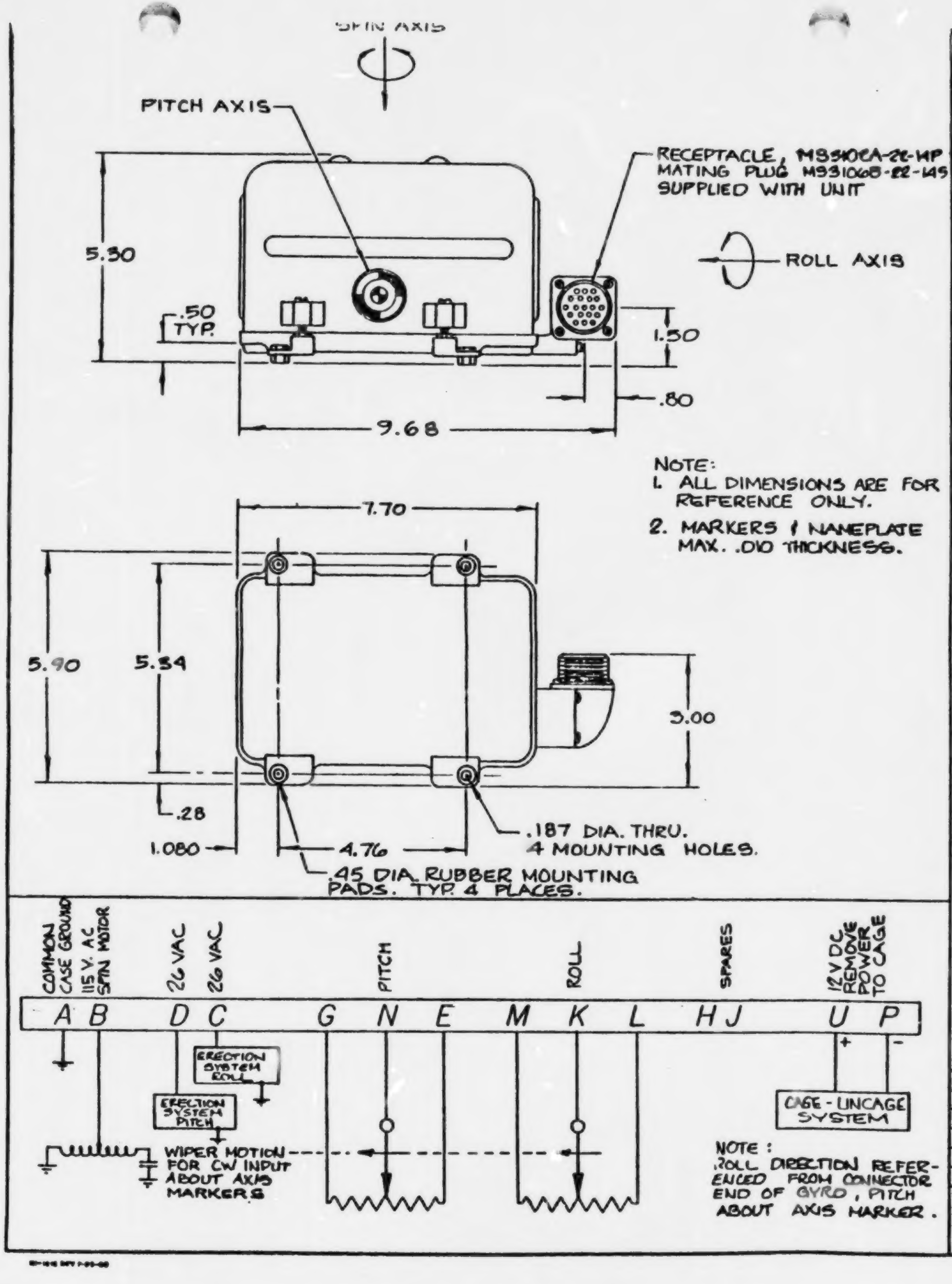

P
U
C
D
B
A
G
E
N
L
M
K
CONNECTOR
F1
F2
S1
S2
GYRO STAND
TERMINAL BLOCK
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
12V dc
1
2
3
4
5
6
TO BRIDGE

FIG. 2.7

CONNECTIONS TO GYRO


SPIN AXIS
PITCH AXIS
RECEPTACLE, MS3102A-22-14P
MATING PLUG MS3106B-22-14S
SUPPLIED WITH UNIT
ROLL AXIS
5.30
.50 TYP.
1.50
.80
9.68
7.70
5.90
5.34
3.00
.28
1.080
4.76
.187 DIA. THRU.
4 MOUNTING HOLES.
.45 DIA. RUBBER MOUNTING PADS. TYP. 4 PLACES.
NOTE:
1. ALL DIMENSIONS ARE FOR REFERENCE ONLY.
2. MARKERS & NAMEPLATE MAX. .010 THICKNESS.
COMMON CASE GROUND
115 V. AC SPIN MOTOR
26 VAC
26 VAC
PITCH
ROLL
SPARES
12V DC REMOVE POWER TO CAGE
A B D C G N E M K L H J U P
ERECTION SYSTEM ROLL
ERECTION SYSTEM PITCH
WIPER MOTION FOR CW INPUT ABOUT AXIS MARKERS
CAGE - UNCAGE SYSTEM
+
-
NOTE :
ROLL DIRECTION REFERENCED FROM CONNECTOR END OF GYRO, PITCH ABOUT AXIS MARKER.

## SPECIFICATIONS

| | | |
|---|---|---|
| 1.0 | ELECTRICAL CHARACTERISTICS | |
| 1.1 | SPIN MOTOR | |
| 1.1.1 | VOLTAGE | 115 VAC, 400 HZ, SINGLE PHASE |
| 1.1.2 | POWER | 50 WATTS STARTING, 20 WATTS RUNNING |
| 1.2 | CAGING CIRCUIT | |
| 1.2.1 | VOLTAGE | 12 VDC |
| 1.2.2 | POWER | 42 WATTS MAXIMUM |
| 2.0 | CAGING TIME | 10 SECONDS NOMINAL |
| *3.0 | CAGING ACCURACY | WITHIN 0.5% OF ELECTRICAL CENTER |
| 4.0 | POTENTIOMETER CHARACTERISTICS | |
| 4.1 | ROLL AND PITCH | |
| *4.1.1 | RESISTANCE | 5.000 ±5.0% OHMS |
| 4.1.2 | RESOLUTION | THEORETICALLY INFINITE |
| 4.1.3 | POWER DISSIPATION | 0.5 WATTS MAXIMUM |
| *4.1.4 | ACTIVE ELEMENT | ROLL ±45° ±2°, PITCH ±45° ±2° |
| 5.0 | MECHANICAL FREEDOM | ROLL ±55°, PITCH ±87° MINIMUM |
| *6.0 | FREE GYRO DRIFT | 0.5°/MINUTE MAXIMUM AVERAGE DRIFT. DRIFT TEST TO BE CONDUCTED ON A SCORSBY TABLE SET AT ±7.5° ROLL, PITCH AND YAW AT RATE OF 6 CPM. SCORSBY TABLE TO BE ON AUTOMATIC REVERSING DURING TEST. GYRO DISPLACEMENT DUE TO EARTH'S ROTATION TO BE CORRECTED FOR WHEN COMPUTING DRIFT RATE. |
| 7.0 | ERECTION MOTORS | |
| 7.1 | VOLTAGE | 26 VAC, 400 HZ, SINGLE PHASE |
| 7.2 | POWER | 5.5 WATTS |
| 7.3 | ACCURACY | ±0.15° OF TRUE VERTICAL |
| 8.0 | REMARKS | |
| 8.1 | ITEMS MARKED WITH (*) ARE CHECKED ON ORDER BY PRODUCTION TESTS. OTHER ITEMS FOR REFERENCE MAY BE CHECKED ON ORDER BY QUALIFICATION TESTS. | |
| 8.2 | THIS INSTRUMENT CONSISTS OF A MINNEAPOLIS HONEYWELL VERTICAL GYRO NUMBER JG7044A MODIFIED TO THE ABOVE SPECIFICATIONS. | |

FIGURE 2.8

CONNECTIONS TO GYRO

REVISIONS (SEE DCN)
A
CUSTOMER REF MATL

Humphrey Inc.
SAN DIEGO, CALIFORNIA
ELECTRO-MECHANICAL INSTRUMENTS

TITLE
ENVELOPE DRAWING
GYROSCOPE -
VERTICAL

DRAWN BY SCHWARTZ
CHECKED BY
APPROVED

UNLESS OTHERWISE SPECIFIED LIMITS ON DIMENSIONS ARE
DECIMAL .XX±.02
.XXX±.010
ANGULAR ±1/2°

SCALE 1/2
DWG SIZE C
MODEL NO. VM02-0127-1
CODE IDENT NO 90204
REV LTR A

## 2.4 Accelerometers

Hull accelerations are obtained at two locations, each fitted with three Entran Devices Inc. Model EGC-240-10D damped accelerometers to measure heave, surge and sway. At the forward location, in the forepeak, the accelerometers are connected to channels 1, 2, and 31 in Box 1. The aft accelerometers in the machinery flat are connected to channels 212, 213, and 214 in Box 6. Each accelerometer has a different sensitivity and has been matched with an amplifier of suitable gain so that outputs of 0V, +5V, +10V correspond to accelerations of -2.5g, 0g, and +2.5g. Because of excessive vibration obscuring the accelerations due to rigid-body motion, low pass filters have been built for use with the accelerometer amplifier cards.

### 2.4.1 Circuit Details

The accelerometers have a nominal sensitivity of 15mV/g for an excitation of 15V dc. 10V dc from the amplifier cards is used as the excitation voltage, however, so a sensitivity of 2/3 that listed is assumed. The sensitivities and gains used are detailed below. The amplifiers use a reference of +5V and have differential inputs so any offsets can be removed using the balance pots (fig. 2.9).

| | Channel | Sensitivity @15V dc | Sensitivity @10V dc | Gain | Gain Resistor | Range |
|---|---|---|---|---|---|---|
| Heave | 1 | 9.6mV/g | 6.4mV/g | 330 | 316 | ±2.5g |
| Sway | 2 | 9.6mV/g | 6.4mV/g | 330 | 301 | ±2.5g |
| Surge | 31 | 15.9mV/g | 10.6mV/g | 250 | 525 | ±2.5g |
| Surge | 212 | 15.2mV/g | 10.1mV/g | 250 | 576 | ±2.5g |
| Sway | 213 | 16.0mV/g | 10.7mV/g | 250 | 523 | ±2.5g |
| Heave | 214 | 16.0mV/g | 10.7mV/g | 250 | 576 | ±2.5g |

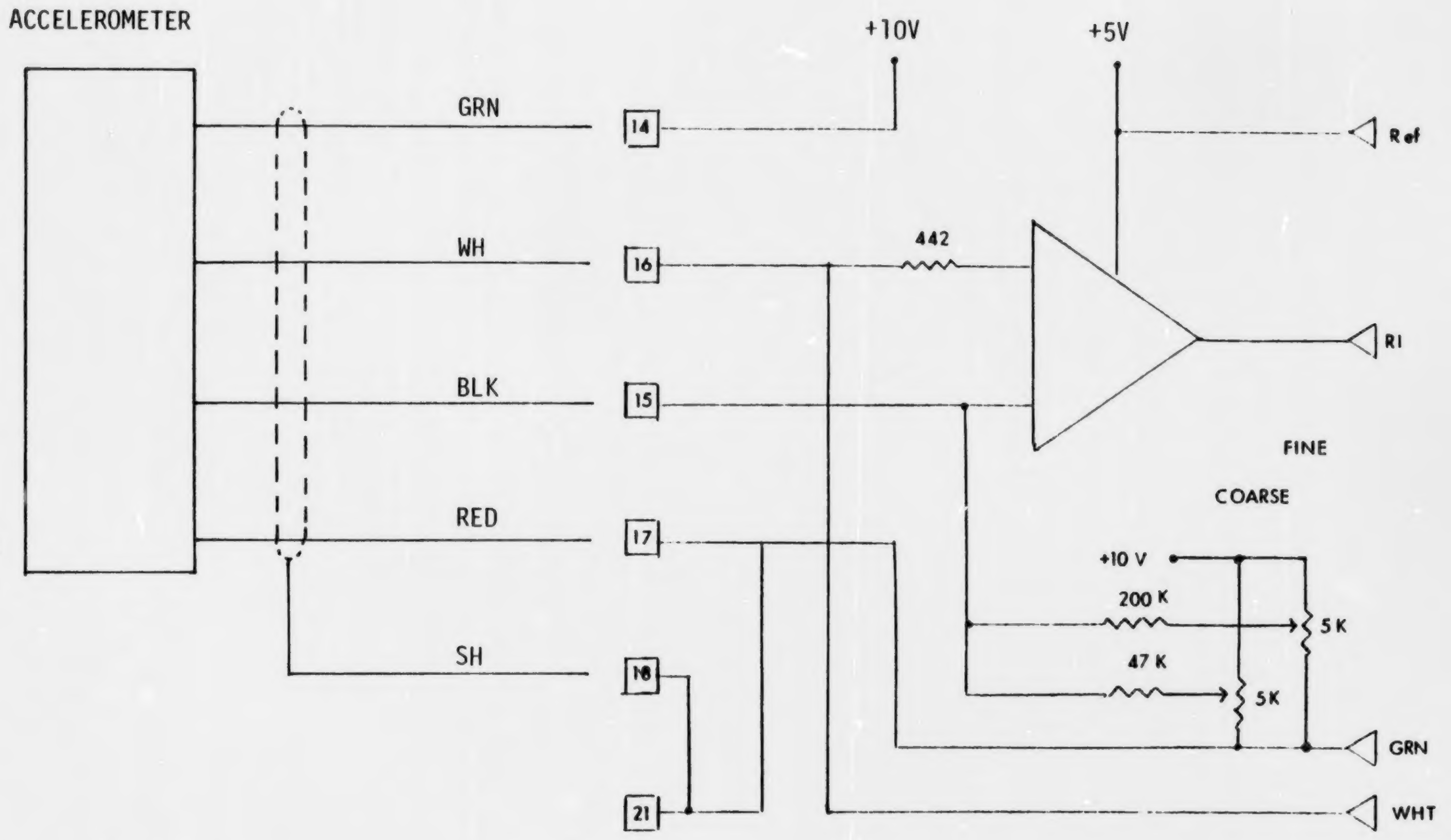

ACCELEROMETER
+10V
+5V
GRN
WH
BLK
RED
SH
14
16
15
17
18
21
442
Ref
RI
FINE
COARSE
+10 V
200 K
47 K
5 K
5K
GRN
WHT

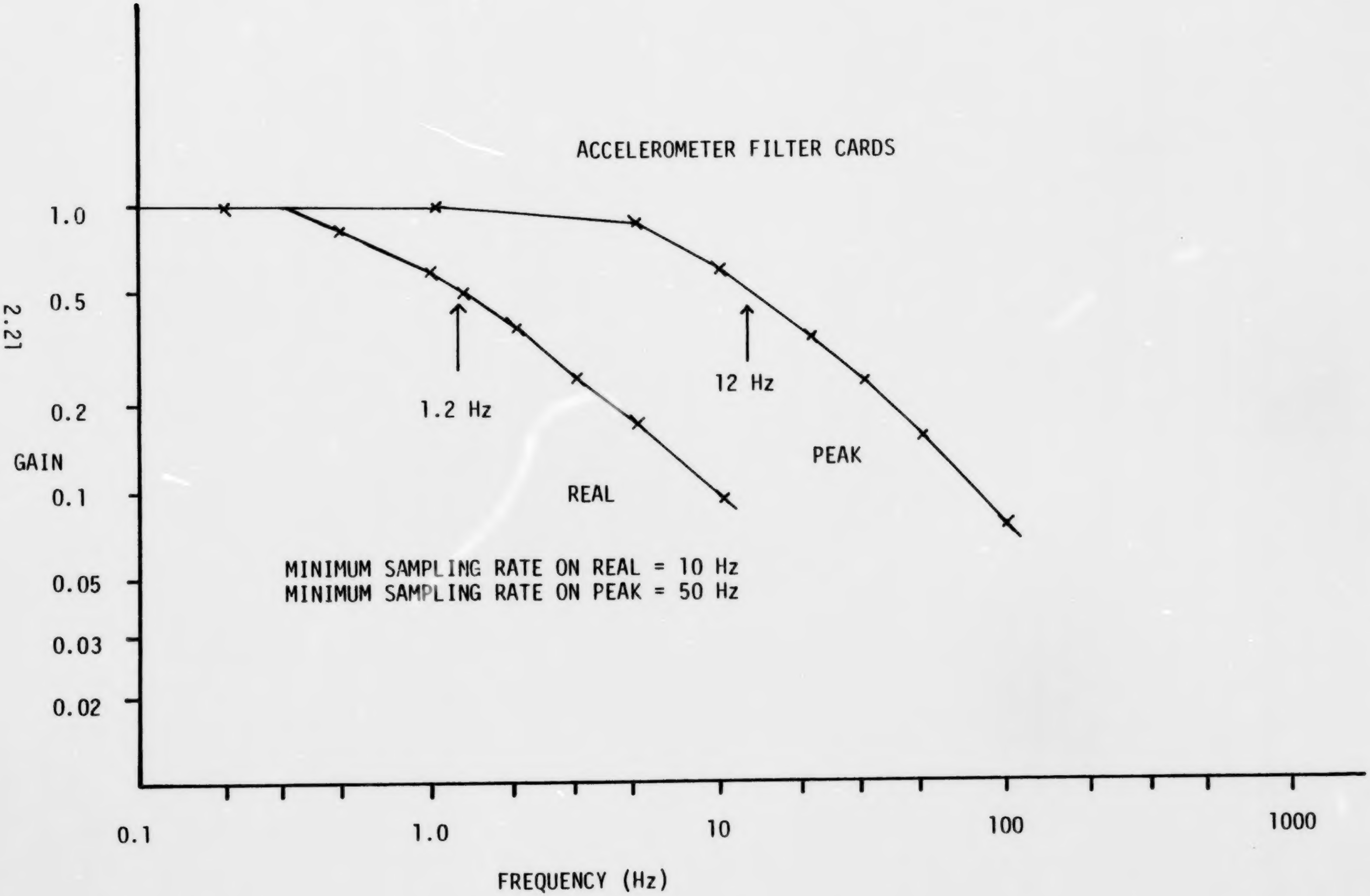
FIG. 2.9
ACCELEROMETERS

### 2.4.2 Calibration Procedure

The accelerometers actually respond to the forces produced by accelerations. Consequently, the force of gravity can be used to calibrate the accelerometers. Each accelerometer is only sensitive to forces along its axis of operation, so tilting an accelerometer will change the effect of gravity on it and produce a measureable output. For example, tilting the surge accelerometer down by 60° and by 90° produces an output corresponding to +0.5g and +1.0g. Similarly, tilting it up by 60° and 90° produces an output corresponding to -0.5g and -1.0g. The same approach can also be used for sway and heave.

### 2.4.3 Low Pass Filters

On the accelerometer filter cards, filter 1 uses a 0.66 F and 200K RC network to give a corner frequency of 1.2Hz, while filter 2 uses a 0.22 F and 100K RC network to give a corner frequency of 12Hz (fig. 2.10). Filter 1, connected to output A (real), is for use at 10 samples/sec while filter 2, connected to output B (peak) is for use at 40 samples/sec. Filter 1 is intended to remove high frequency vibrations and give a clear record of the rigid-body accelerations affecting the ship. Filter 2 is available to give higher frequency details, if required.



MINIMUM SAMPLING RATE ON REAL = 10 Hz
MINIMUM SAMPLING RATE ON PEAK = 50 Hz

FIG. 2.10

# SECTION 3

# PROPULSION MACHINERY INSTRUMENTATION

# Section 3: Propulsion and Steering Instrumentation

- 3.1 Propellor Command/Response
  - 3.1.1 Circuit Details
- 3.2 Rudder Command/Response
  - 3.2.1 Circuit Details
- 3.3 Prop. and Rudder Differential Pressure
  - 3.3.1 Circuit Details
  - 3.3.2 Pressure Transducer
- 3.4 Fuel Flow
  - 3.4.1 Circuit Details
- 3.5 Thrust
  - 3.5.1 Circuit Details
  - 3.5.2 Setting up procedure
  - 3.5.3 Renk-checker thrustmeter
- 3.6 Shaft Torque
  - 3.6.1 External Connections
  - 3.6.2 Torquemeter
- 3.7 Shaft R.P.M.

## Propulsion and Steering Measurements

Measurements are made to determine i) the power delivered to the propeller, and ii) the effect of ice impacts on the propeller and rudder. The propeller is located in a duct to increase its efficiency at slow speeds, so the thrust delivered by the propeller is not necessarily the same as the thrust delivered to the ship.

The thrust delivered by the propeller is measured by a Renk-Checker thrustmeter which incorporates a load cell in the gear box. Another measure of thrust can be obtained from the measurements of Shaft Torque and Shaft RPM. Measurements of the fuel rack setting provide an indication of the rate of fuel consumption and hence give an indirect measure of the power delivered by the engine. Average cruising consumption at 15 knots = 111 kg/mile = 1665 kg/hour.

The engine normally runs at 360 to 450 rpm and is connected through a fixed ratio gearbox and clutch to the shaft. At slow speeds the pitch of the propeller, rather than its rpm, is used to control the speed of the ship.

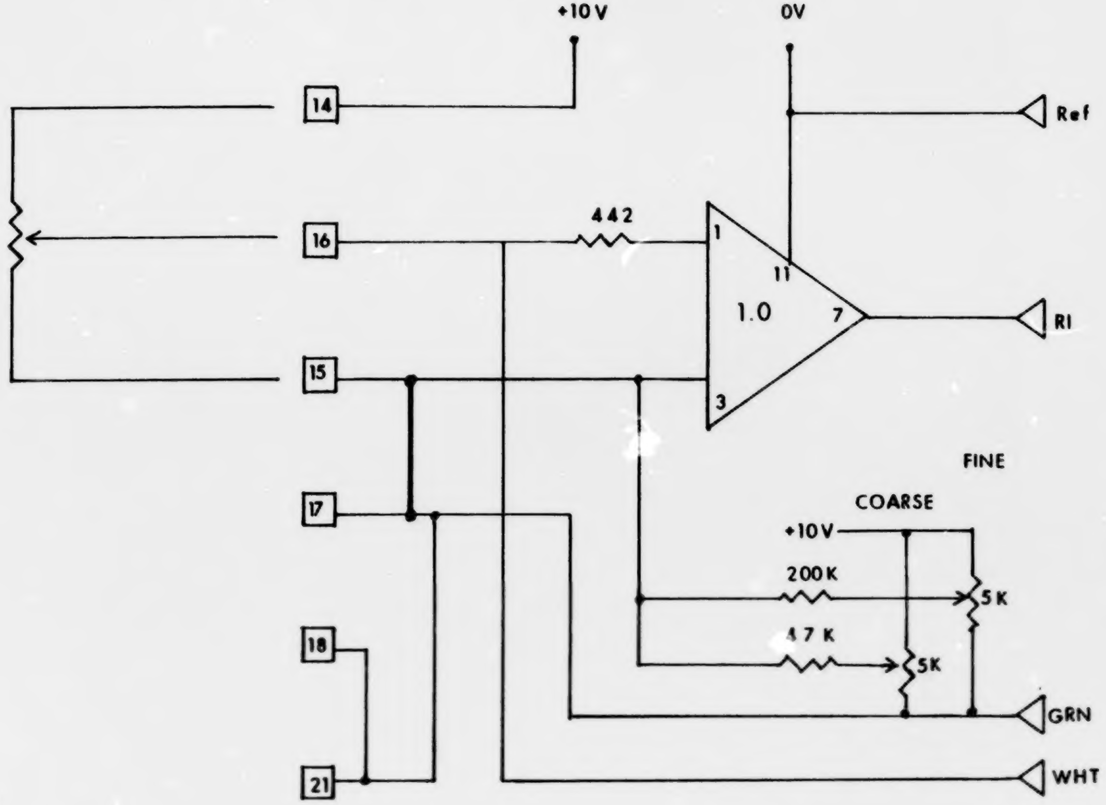
## 3.1 Propeller Pitch Command and Response

Propeller pitch command signals are obtained from a potentiometer connected to the pitch control mechanism on the bridge console; and propeller response from a potentiometer connected to the pitch angle indicating mechanism on the OD Box. The 'command' potentiometer is connected to channel 244 in box 7 on the bridge, while the 'response' potentiometer is connected to channel 201 of box 6 in the engine room.

Command settings are on a scale of -10 to 0 to +10, while the response is measured in degrees: ranging from -22° to 0° to 22°.

### 3.1.1 Circuit Details

For command or response, the full scale settings give outputs from the potentiometers of 0V and +10V. The amplifier uses a reference of 0V and gain of 1 to pass on the potentiometer signal. Excitation for the potentiometers is +10V from the voltage regulator on the amplifier card (fig. 3.1).



+10V
0V
14
Ref
442
16
1
11
1.0
7
RI
15
3
FINE
COARSE
17
+10V
200K
5K
47 K
5K
18
GRN
21
WHT

FIG. 3.1
PROPELLER COMMAND (RESPONSE)

## 3.2 Rudder Command and Response

Rudder command signals are obtained from a potentiometer connected to the wheel on the bridge; and rudder response from a potentiometer connected to the rudder stock in the steering flats. The 'command' potentiometer is connected to channel 245 in box 7 on the bridge, while the 'response' potentiometer is connected to channel 200 of box 6 in the engine room. Command and response settings are both on a scale of -45° to +45° (stbd).

### 3.2.1 Circuit Details

Excitation for the potentiometers comes from the +10V regulator on the amplifier card through a 570 resistor so giving approx. 0V to +9V across the potentiometer. The amplifier has a reference of 0V and a gain of 1, so that at the out 1V corresponds to 10° (fig. 3.2)

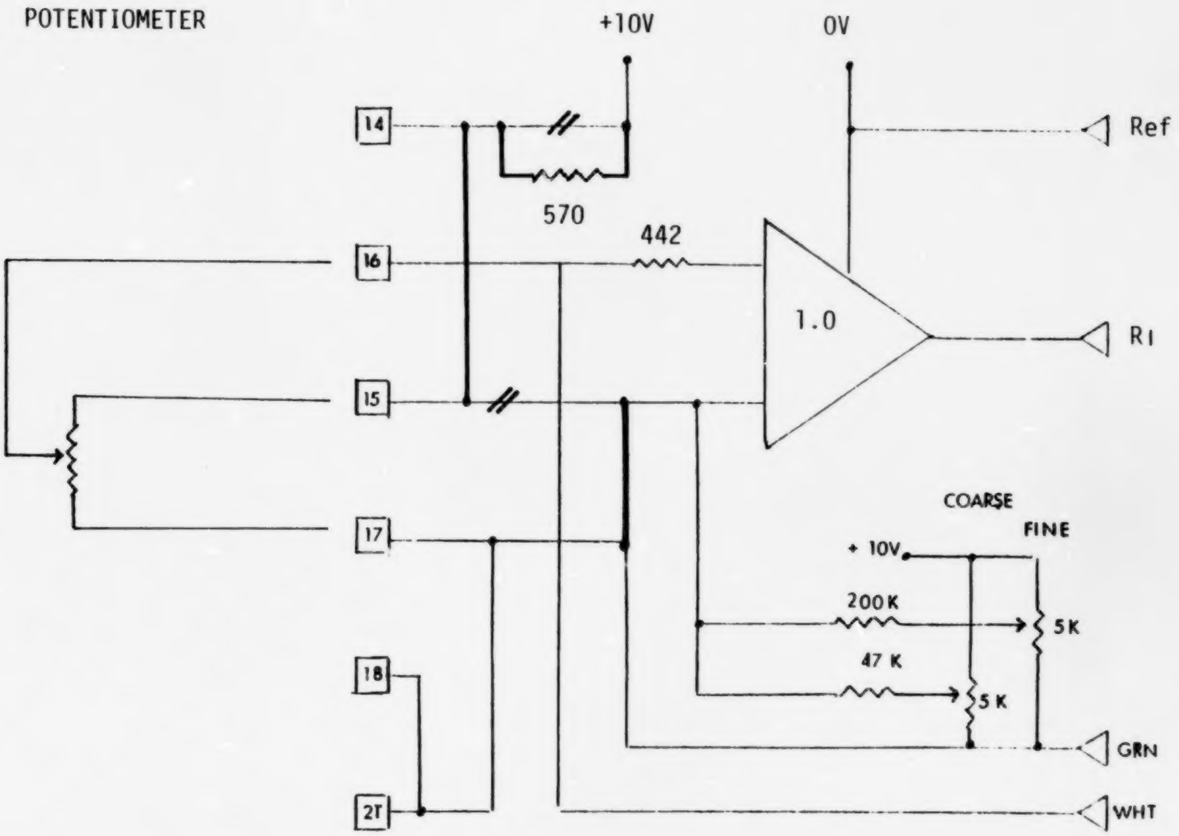

POTENTIOMETER
+10V
0V
14
16
15
17
18
2T
570
442
1.0
Ref
R1
COARSE
FINE
+ 10V
200K
47 K
5K
5 K
GRN
WHT

FIG. 3.2
RUDDER COMMAND (RESPONSE)

## 3.3 Propeller and Rudder Differential Pressure

Information is required on the forces on the rudder and propeller produced by ice impacts. It proved impossible to instrument the rudder and propeller directly so measurements are made in each case of the difference in pressure between the two hydraulic control rams. Propeller differential pressure is measured using a SE21/V/2000 pressure transducer connected to channel 203 of box 6 in the engine room. Rudder differential pressure measurements use a SE21/V/5000 pressure transducer connected to channel 202 of box 6.

### 3.3.1 Circuit Details

24V dc for excitation of both transducers is provided by a Llambda 24V power supply - type LJS-10, 240V mounted in Box number 6. This excitation voltage is brought out through the plug for channel 223. Both transducers give ±1V outputs for full scale pressure differences. Consequently, amplifiers with +5V reference and a gain of 5 are used to give a 0 to +10V output in range (fig. 3.3).

### 3.3.2 Pressure Transducers

Manufacturers specifications for the transducers used are shown

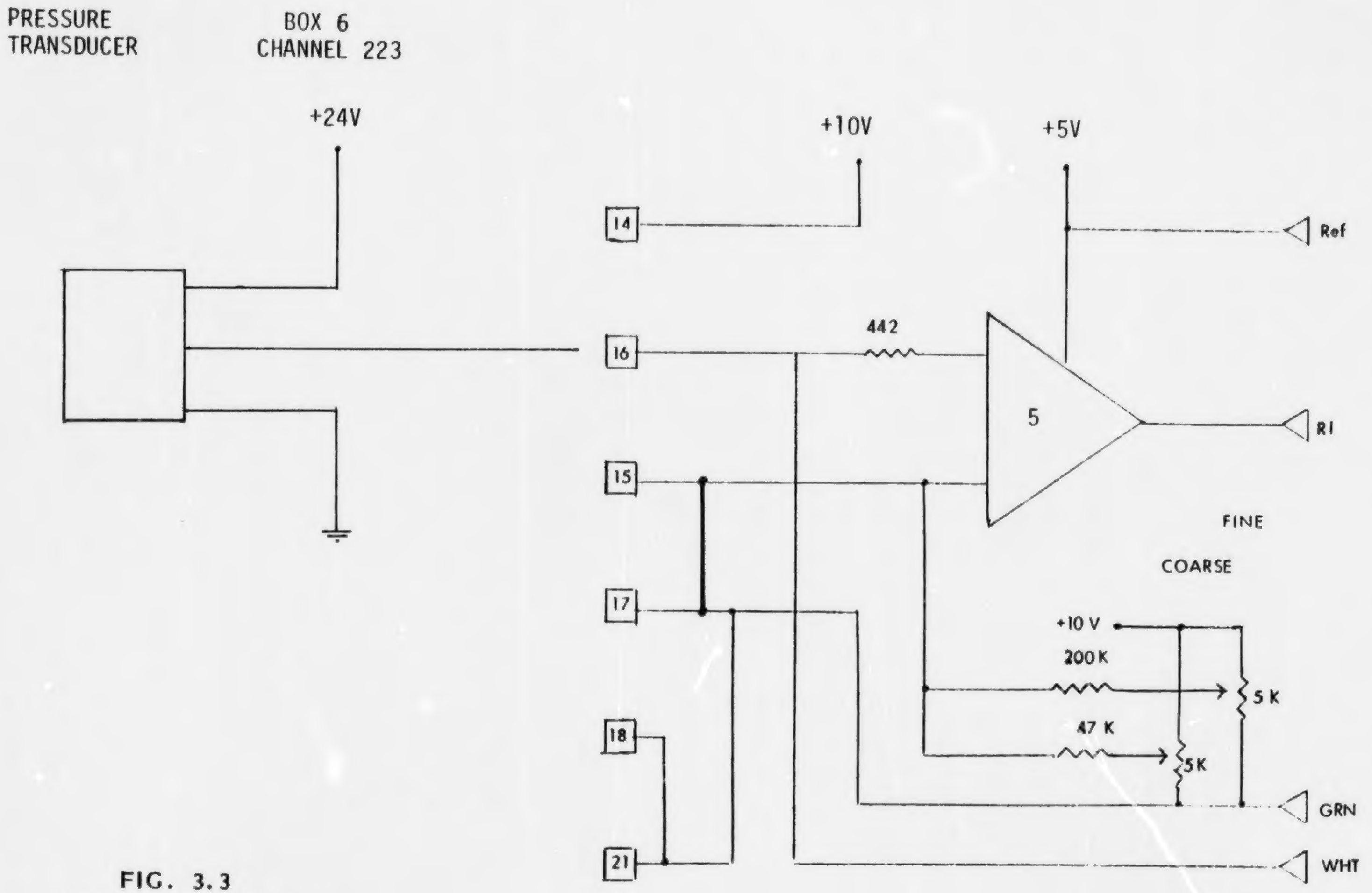

PRESSURE
TRANSDUCER
BOX 6
CHANNEL 223
+24V
+10V
+5V
14
16
15
17
18
21
442
5
Ref
RI
FINE
COARSE
+10 V
200 K
47 K
5 K
5 K
GRN
WHT

FIG. 3.3
DIFFERENTIAL PRESSURE

## 3.4 Fuel Flow

To obtain a measure of the rate of fuel consumption by the engine, a potentiometer is linked to the fuel rack mechanism on the starboard side of the engine. For the engine's operational range of 360 to 450 rpm, the fuel consumption in kg. per hour is given by:

$$\text{Fuel Consumption} = 72.08 \times FR - 2780.83$$

where FR = Fuel Rack setting in mm.

### 3.4.1 Circuit Details

The fuel rack potentiometer is connected to channel 199 in box 6. Excitation for the potentiometer comes from the +10V voltage regulator on the amplifier card through a 570 OHM resistor, so giving approx. 9.5V across the potentiometer. The amplifier has a gain of 1 and uses a reference voltage of 0V (fig. 3.4).

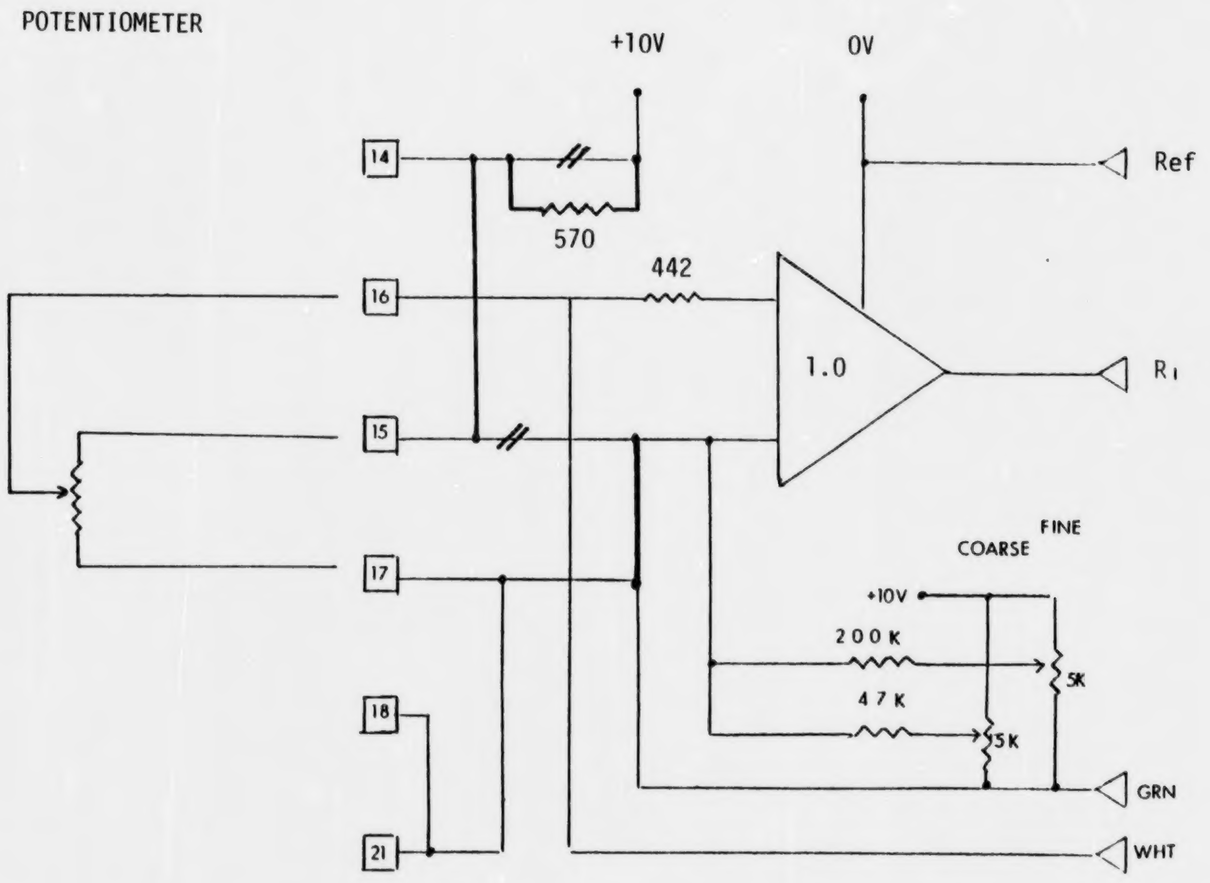

POTENTIOMETER
+10V
0V
Ref
570
442
1.0
R₁
14
16
15
17
18
21
COARSE
FINE
+10V
200 K
47 K
5K
5K
GRN
WHT

FIG. 3.4
FUEL RACK

## 3.5 Thrust

A Renk-checker Type RC1K-3 thrustmeter located next to box 6 in the engine room is connected to channel 198 in that box.

### 3.5.1 Circuit Details

With the high input impedance of the amplifier used on the amplifier cards, the thrustmeter output can be regarded as a voltage source and adjusted as required. The amplifier has a reference voltage of +5V and a gain of 0.5 to convert the ±10V output of the thrustmeter (corresponding to ±120 tonnes) to a 0V +10V output (fig. 3.5).

### 3.5.2 Setting up procedure

The thrustmeter must be zeroed when the engine oil is at operating temperature (ie. just after engine shutdown).

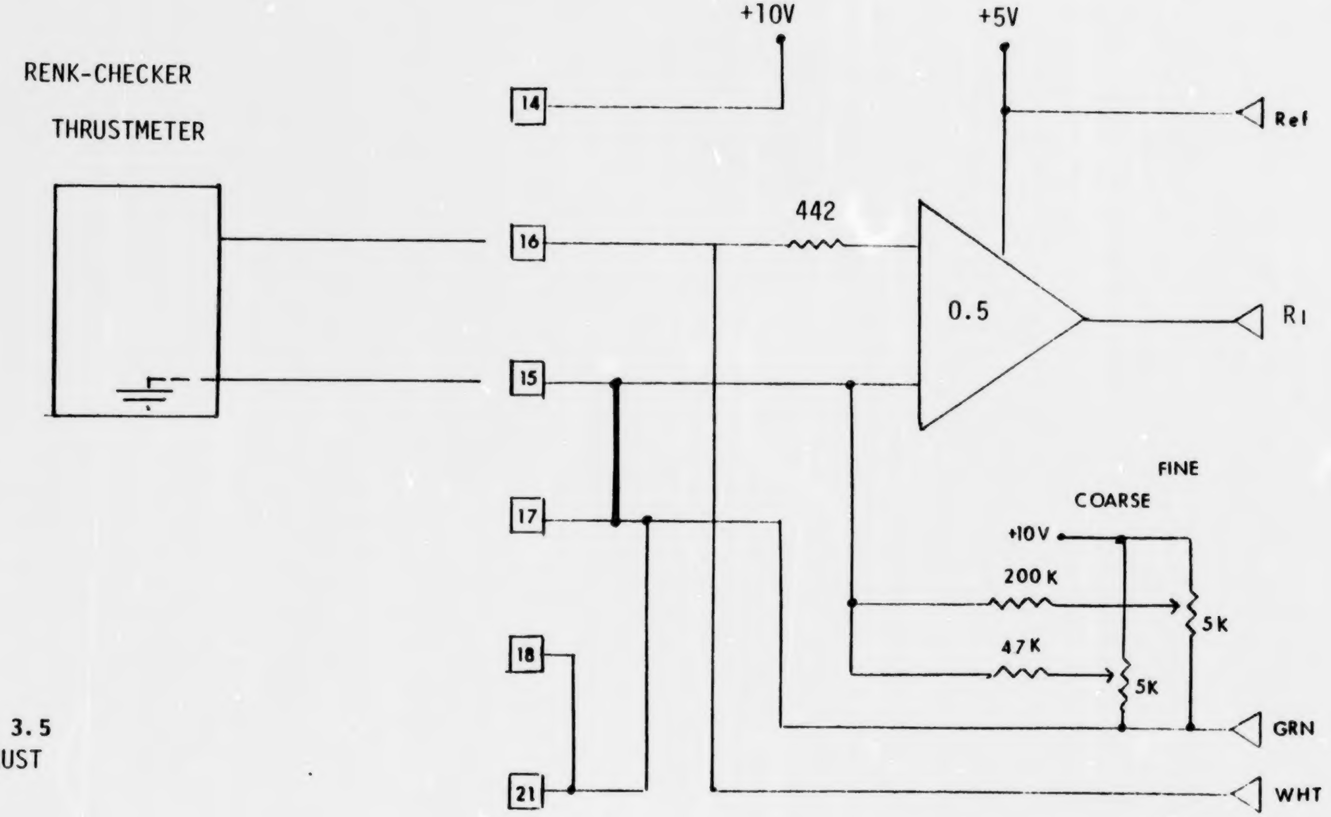

RENK-CHECKER
THRUSTMETER
14
16
15
17
18
21
+10V
+5V
442
0.5
Ref
R1
FINE
COARSE
+10V
200 K
47 K
5K
5K
GRN
WHT

FIG. 3.5
THRUST

## 3.6 Torque

Shaft torque is obtained from a specially designed torquemeter attached to the propeller shaft between the gearbox and the propeller pitch control OD Box. The output signal is passed by a Telemetry system, the transmitter on the shaft and the receiver in an adjacent cabinet, to channel 208 in Box 6. The amplifier has a reference voltage of 0V and a gain of 5 with a differential input, but the amp. balance has been adjusted to give an output $V_{RL} \approx$ 1.0V for Torque = 0 (fig. 3.6).

A torque on the shaft produces a certain strain at the surface of the shaft. This is measured by a strain gauge bridge producing a voltage signal which is transmitted to the receiver unit. The display on the receiver unit gives the voltage signal in mV. This signal also goes to the amplifier card input.

### 3.6.1 Calibration of the Torquemeter (Fig. 3.8)

'Zero' Offset

Because of S/G drift and drifts in the F.M. telemetry system, zero torque does not produce 0 volts output from the torquemeter, so it is necessary to establish the 'zero' offset. To do this, it is not possible to simply take the reading when the shaft is stationary because friction in the bearings always results in a residual torque when the shaft stops. To overcome this, the shaft must be rotated slowly (using the turning gear) for one revolution, first one way and then the other, while readings are taken every minute. The average of these readings can then be taken as the output level for zero torque.

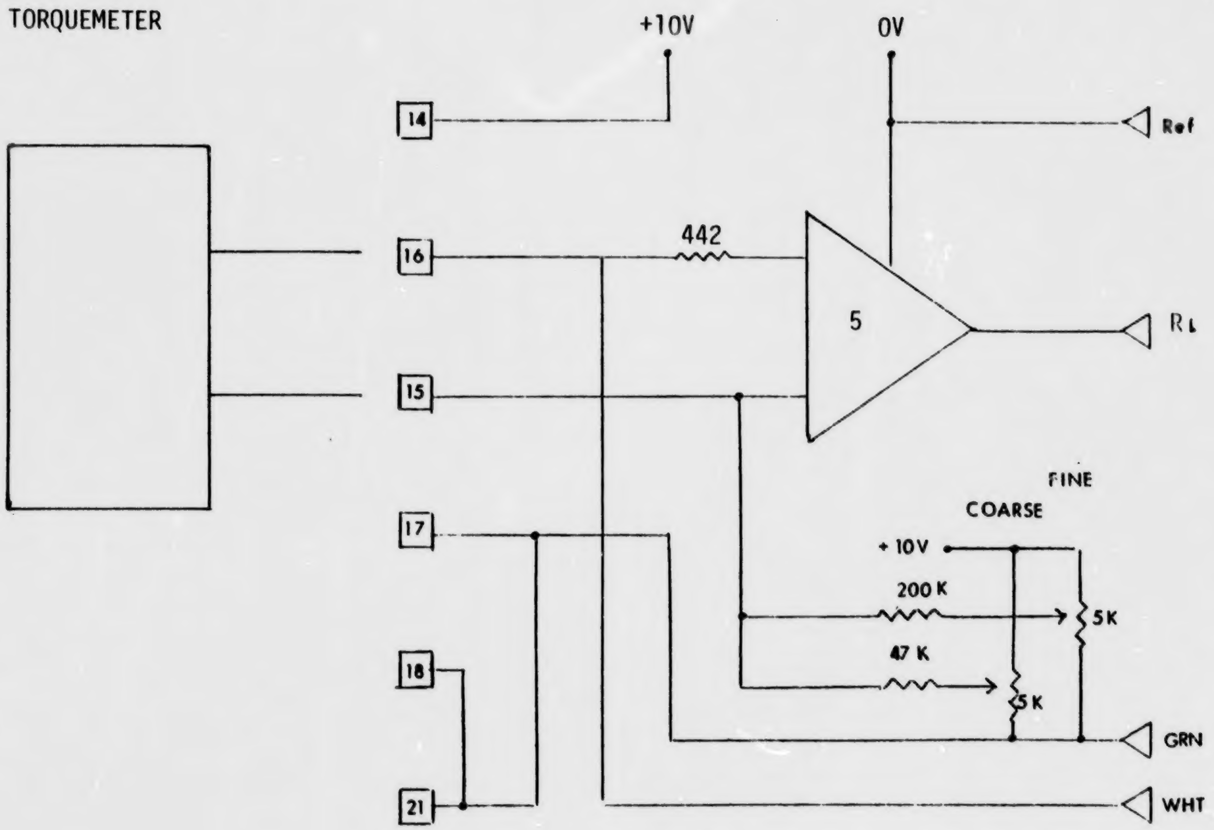

TORQUEMETER
+10V
0V
14
Ref
16
442
5
RL
15
FINE
COARSE
17
+ 10V
200 K
5 K
47 K
5 K
18
GRN
21
WHT

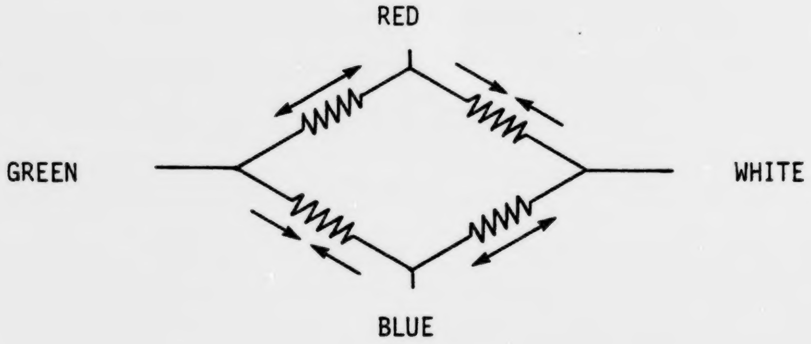
FIG. 3.6
TORQUE

### Slope

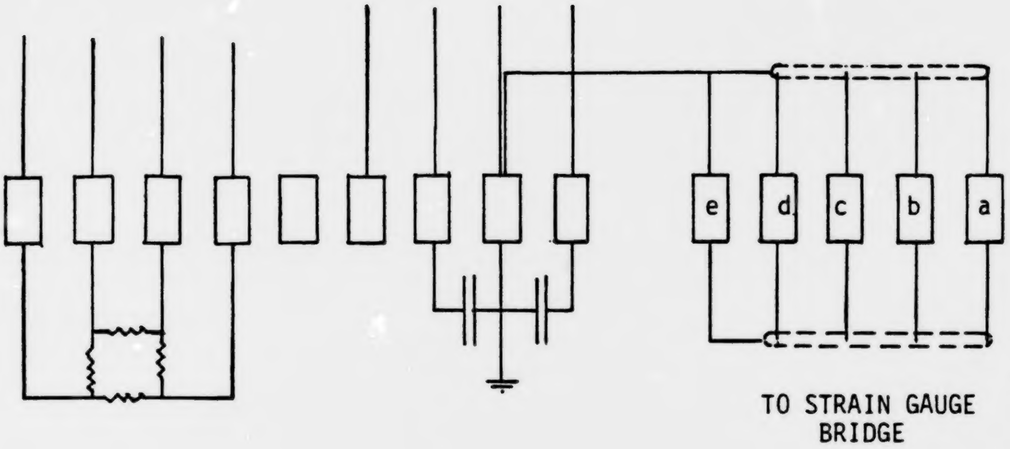
Because there is a linear relationship between strain and torque, changing the S/G resistance to simulate a certain strain is equivalent to simulating the corresponding torque. This can be done by shunting one arm of the S/G bridge on the shaft with known resistors. These should be connected across terminals 'b' and 'c' as shown in fig. 3.7. Recommended shunt resistors are:

1 M
400 K
200 K
150 K
100 K
75 K
66 K

The strain gauge circuit is as follows:



with all resistances 120 Ω. Extensive strain gauges are marked (←→), compressive gauges are marked (→←).


e
d
c
b
a
TO STRAIN GAUGE BRIDGE

TORQUEMETER CONNECTIONS ON THE SHAFT

FOR CALIBRATION CONNECT SHUNT RESISTORS ACROSS b AND c

**FIG. 3.7**

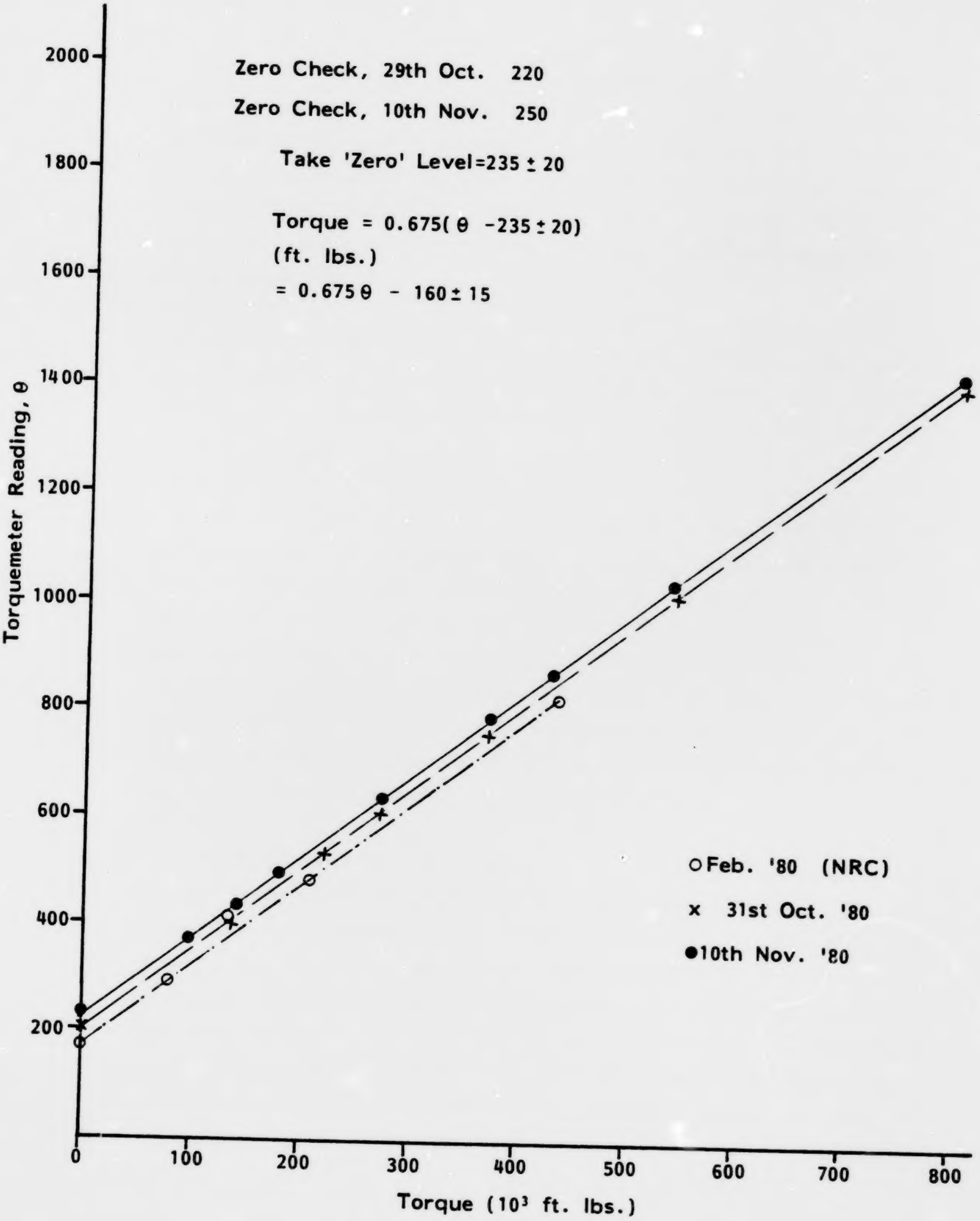


FIGURE 3.8 CALIBRATION OF TORQUEMETER

## 3.7 Shaft RPM

A search coil mounted above the shaft gives a signal every time a magnet strapped to the shaft goes by (fig. 3.9). This signal is amplified by the card in channel 209 and by sampling this channel at '10 samples/sec. peak' a pulse is recorded on tape every time the shaft goes one revolution. This pulse can be one or two values wide. On playback, a count of the pulses in each minute provides a measure of the shaft RPM.

The above technique has an inherent stability, however, for reasonable accuracy a substantial amount of hand or computer post analysis is required. To augment this system an analogue circuit has been added in channel slots 210 and 211.

Figure 3.9 is the circuit diagram of the new system which works as follows. At normal operating speed the pulse at the real output of Ch 209 has on complitude of 1.5v - 2v, positive going. By a flying lead it is brought to the AC coupled noninverting input of a x10 amplifier (location ZE). The amplifier output is available at a test point. This output is squared by a D flipflop set up as a 50 mS monstable vibrator, then split into two phases by a D flipflop set up as a toggling flipflop. The two phases are converted to short pulses by two 1 microsecond monostable vibrators.

One phase resets a counter (4040) which is set to increment every 4.000 mS (crystal derived count). The second phase clocks the current count into an 8 bit latch (2 x 4042). Since the time between the two phases equals the rotation period of the shaft, the count stored in the latch is a binary number directly proportional to the shaft period. The latch has maximum capacity of 1020 mS, hence shaft RPM's less than 58.82 RPM will fold around, hence give false readings. This will not normally be a problem since the shaft is normally operated faster than this rate.

Finally the latch outputs feed to a resistor array D/A converter. The array produces an analogue signal, range 0-10v, directly proportional to the shaft period. Nominally 0v = 0 period, 10v = 1023 mS period. This calibration is directly dependent on the 15v supply regulation.

A flying lead takes this signal to the CAL point of Ch 211. The card is set to nominal unity gain and trimmed so that Ch 211 REF gives 10 mV deflection for every mS of period change.

(This section to be changed or deleted when software modifications are effected.)

Currently Ch 211 monitoring is in software volts. To convert to rotation period in mS a least squares calibration has been done. The conversion equation is:

Period (mS) = ((software volts) + 10.09) ÷ 0.02006

More simply:

Period (mS) = ((software volts) + 10) x 50

which is accurate to within 1%. Total system accuracy is nominally ±1%.

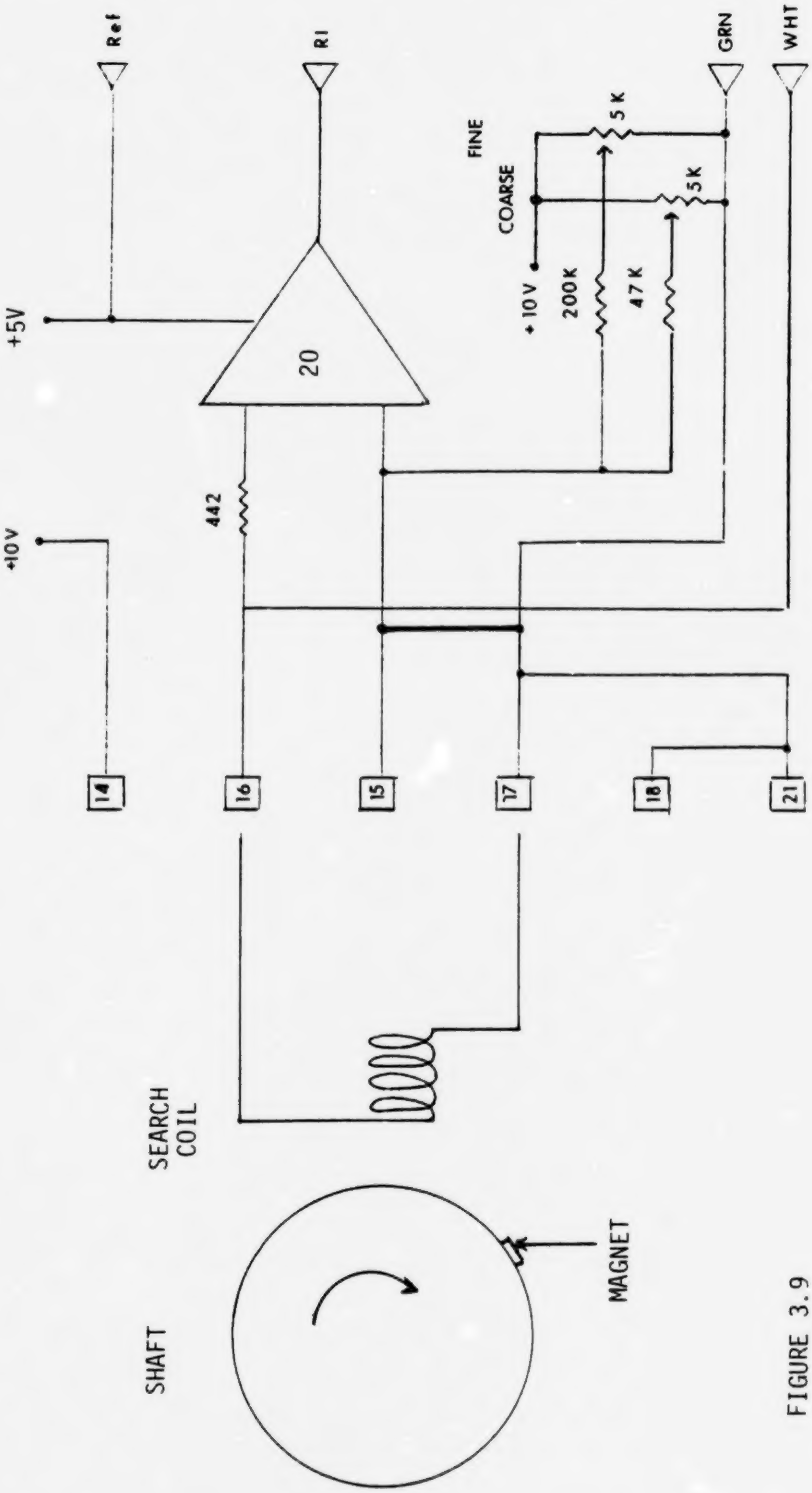
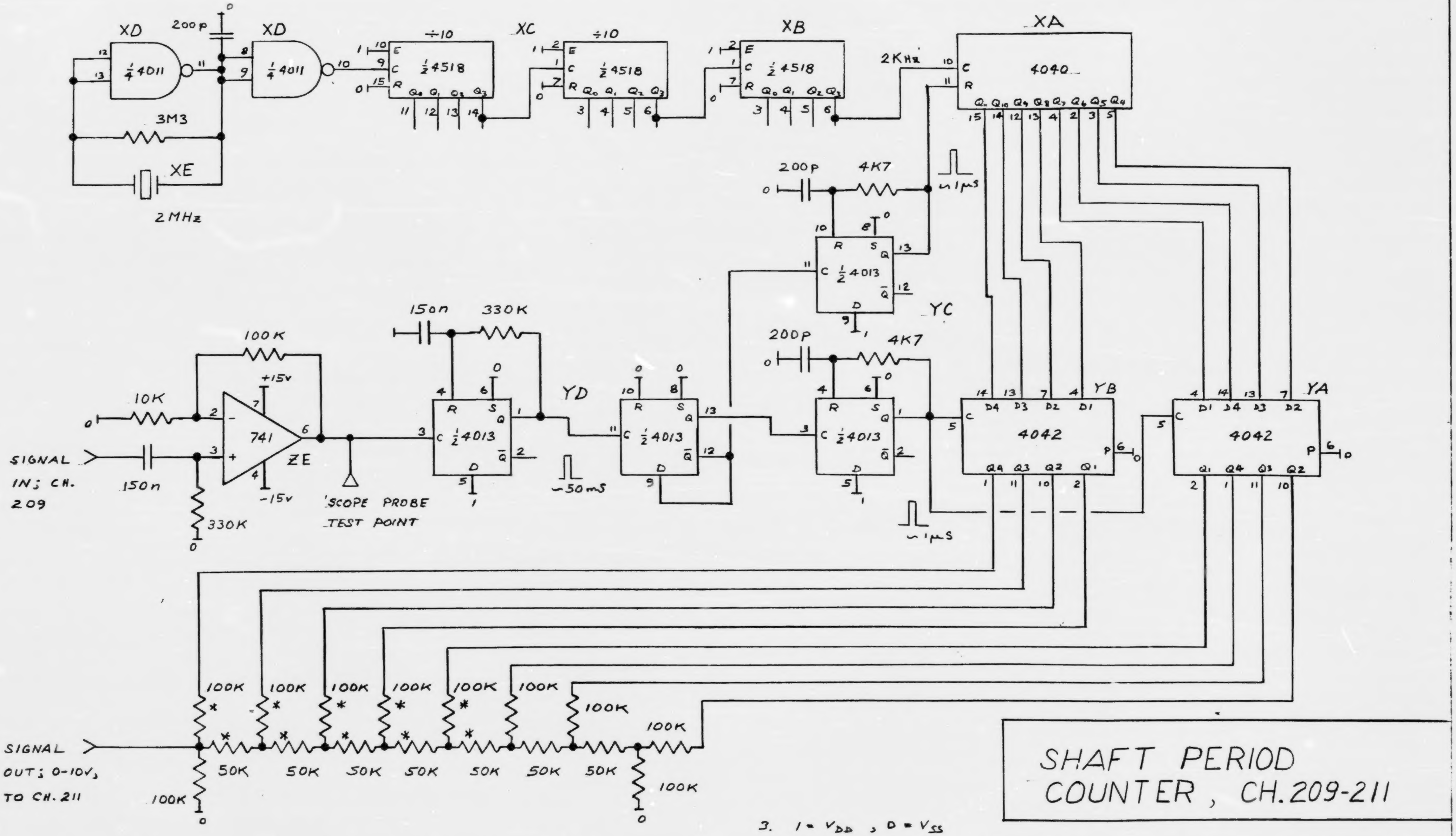

Ref
R1
GRN
WHT
FINE
COARSE
5K
5K
+10V
200K
47K
+5V
20
442
+10V
14
16
15
17
18
21
SEARCH COIL
SHAFT
MAGNET

FIGURE 3.9

SHAFT RPM


XD
200p
XD
1/4 4011
1/4 4011
3M3
XE
2MHz
÷10
XC
1/2 4518
÷10
1/2 4518
XB
1/2 4518
2KHz
XA
4040
Q11 Q10 Q9 Q8 Q7 Q6 Q5 Q4
200P
4K7
~1µS
1/2 4013
YC
200P
4K7
~1µS
150n
330K
100K
10K
+15V
741
ZE
-15V
SIGNAL IN; CH. 209
150n
330K
'SCOPE PROBE TEST POINT
1/2 4013
YD
~50mS
1/2 4013
1/2 4013
4042
YB
D4 D3 D2 D1
Q4 Q3 Q2 Q1
4042
YA
D1 D4 D3 D2
Q1 Q4 Q3 Q2
100K*
50K*
50K
100K
SIGNAL OUT; 0-10V, TO CH. 211

SHAFT PERIOD
COUNTER, CH. 209-211

NOTES:

1. POWER = ±15V; +15V ON EDGE PIN 9 = $V_{DD}$; −15V ON EDGE PIN 22; GND ON EDGE PIN L = $V_{SS}$.
2. ALL RESISTORS 5%, 1/4W UNLESS NOTED.
3. 1 = $V_{DD}$, 0 = $V_{SS}$
4. * = "NOMINAL VALUES 100K OR 50K SELECTED FOR RAMP LINEARITY"
5. ALL CMOS DEVICES RCA TYPE CD4xxx BCP

FIG. 3.10

# SECTION 4

# AUXILIARY SYSTEMS INSTRUMENTATION
(BUBBLER SYSTEM)

# Section 4: Bubbler System Instrumentation

- 4.1 Bubbler Pressure
  - 4.1.1 Circuit Details
  - 4.1.2 Pressure Transducers
- 4.2 Valve Positions
  - 4.2.1 Circuit Details
  - 4.2.2 Valve Position Translator

## 4.1 Bubbler Pressure

Instrumentation has been installed to monitor the operation of the bubbler system. Measurement of the air pressure at the compressors is made utilizing two (2) transducers installed in the primary manifolds, and there is provision for two extra pressure measurements within the air distribution system if they should be found necessary.

The air pressure transducers are located in the Bubbler Compartment, at the aft ends of the two primary air manifolds. The one on the starboard side is directly behind Subjunction Box 5, which is facing the aft end of the starboard catwalk.

### 4.1.1 Circuit Details

The transducers need a 6Vdc excitation so a voltage converter is used to supply this from the 10V regulator on the amplifier card. The amplifier has a reference of 0V and a gain of 330 giving an output of 0 to +10V corresponding to pressures of 0 to 20 psi (fig. 4.1). The starboard and port transducers are connected to channels 187 and 188 respectively.

### 4.1.2 Pressure Transducers

The pressure transducers selected are Entran Devices Inc., Model EPS-1032-50. A descriptive leaflet is included at the end of this section.

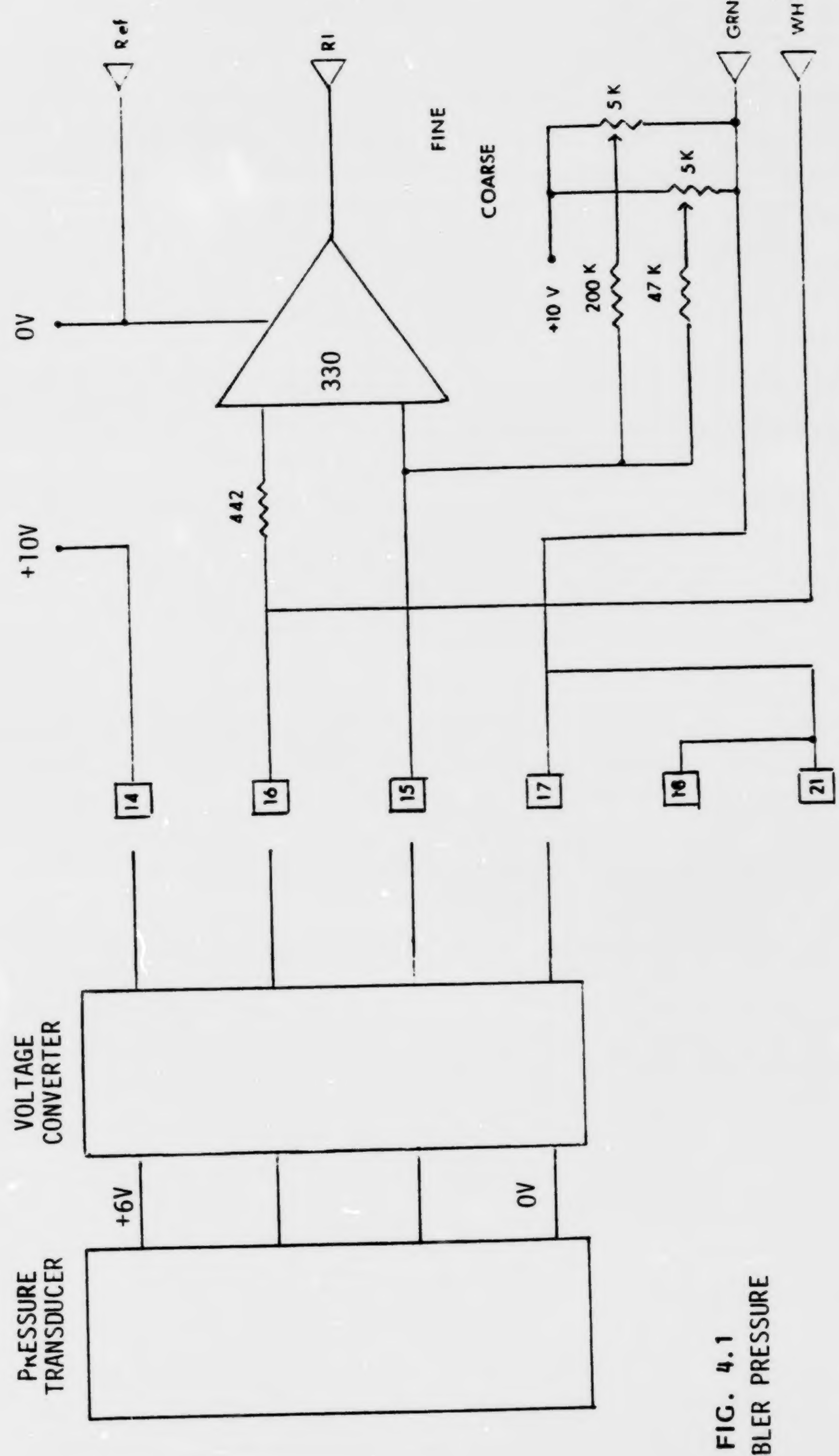

PRESSURE TRANSDUCER
VOLTAGE CONVERTER
+6V
0V
14
16
15
17
18
21
+10V
0V
442
330
Ref
R1
FINE
COARSE
+10 V
200 K
47 K
5 K
5 K
GRN
WHT

FIG. 4.1
BUBBLER PRESSURE

## 4.2 Valve Position Translators

There are four control valves, one to each of the thruster and bubbler pipes, starboard and port. There are two blowoff valves. The layout of the bubbler system is shown in fig. 4.2.

Schematics for the valve position translators and terminal blocks are given in figs. 4.3 and 4.4.

The valve position translators are located in the console in the Engine Control Room and are connected to Subjunction Box No. 6.

Port Bubblers : Ch 204
Stbd Bubblers : Ch 205
Thrusters and Blow-offs : Ch 206

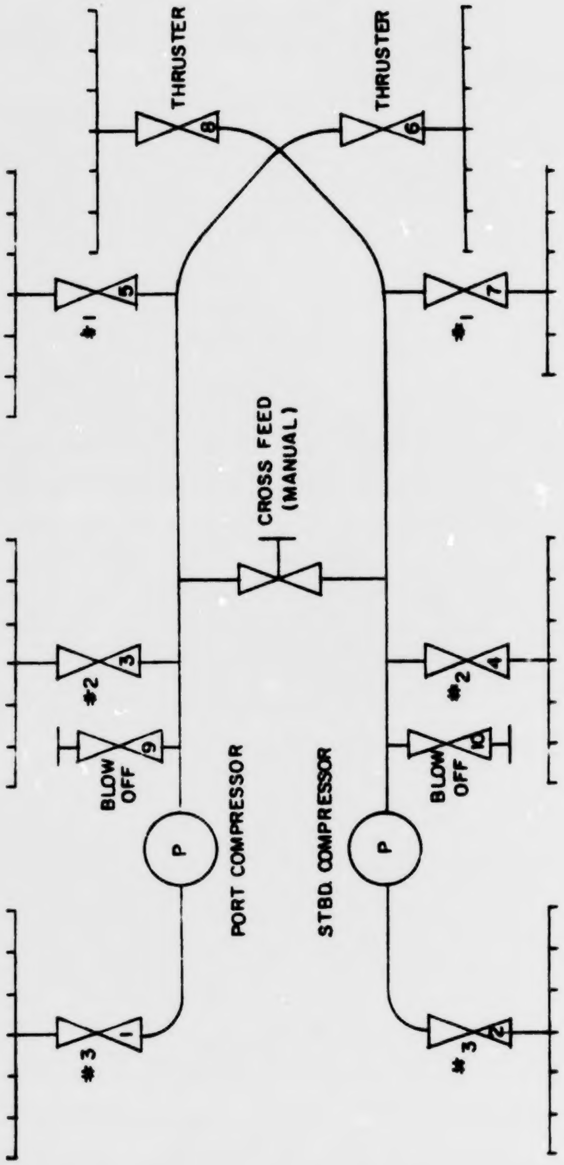
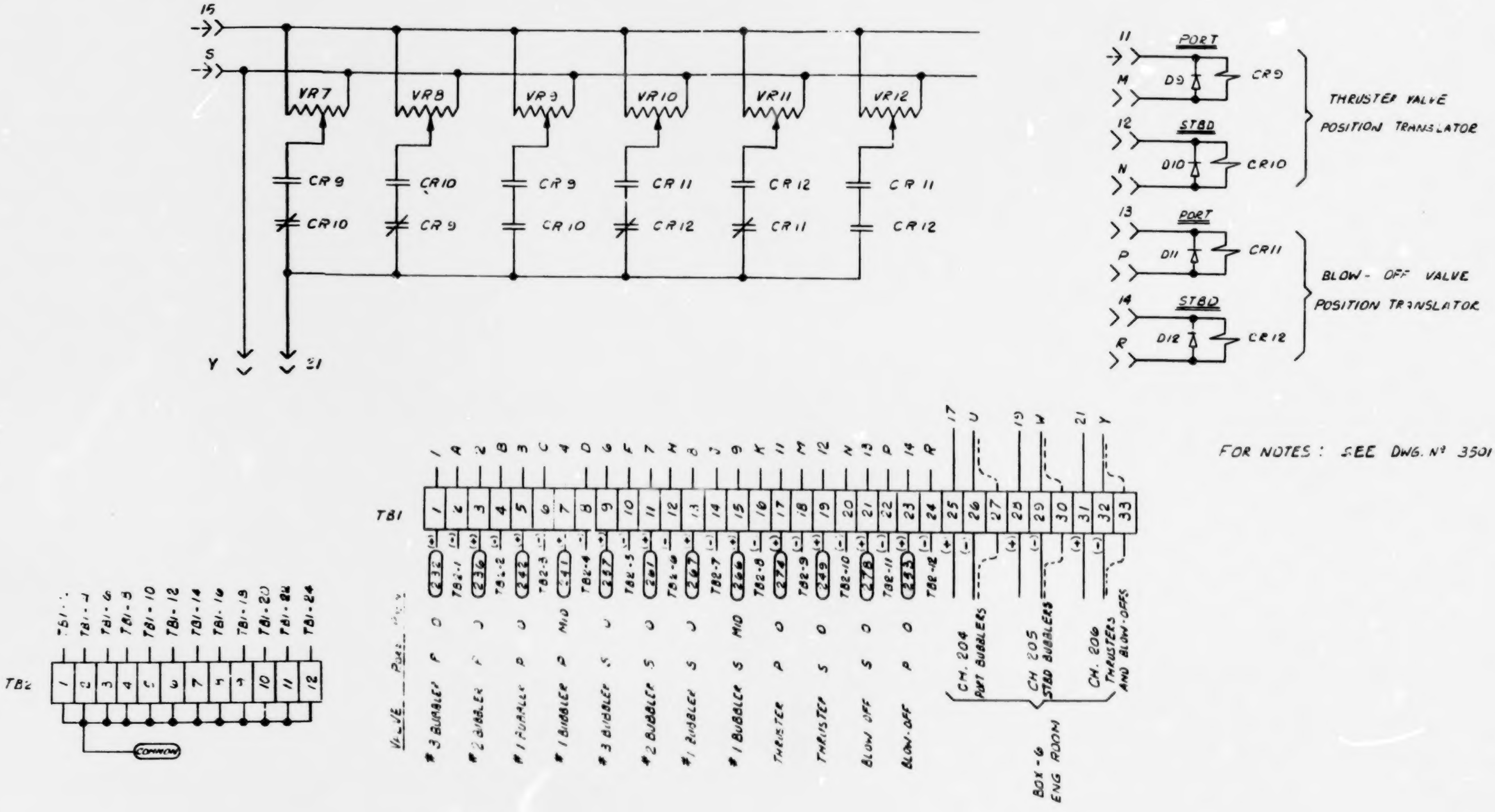

THRUSTER
8
THRUSTER
6
#1
5
#1
7
CROSS FEED
(MANUAL)
#2
3
#2
4
BLOW
OFF
9
BLOW
OFF
10
P
PORT COMPRESSOR
P
STBD. COMPRESSOR
#3
1
#3
2

FIGURE 4-2 LAYOUT - BUBBLER SYSTEM

## Note on Section 4

These circuits were changed to incorporate relay drivers between 12V bubbler signals and relays.


15
S
VR7
VR8
VR9
VR10
VR11
VR12
CR9
CR10
CR9
CR11
CR12
CR11
CR10
CR9
CR10
CR12
CR11
CR12
Y
21
11
PORT
M
D9
CR9
12
STBD
N
D10
CR10
THRUSTER VALVE POSITION TRANSLATOR
13
PORT
P
D11
CR11
14
STBD
R
D12
CR12
BLOW-OFF VALVE POSITION TRANSLATOR
TB1
1 A 2 B 3 C 4 D 6 F 7 H 8 J 9 K 11 M 12 N 13 P 14 R 17 U 19 W 21 Y
232
TB2-1
236
TB2-2
242
TB2-3
241
TB2-4
237
TB2-5
261
TB2-6
267
TB2-7
266
TB2-8
274
TB2-9
249
TB2-10
278
TB2-11
243
TB2-12
VALVE
POS.
# 3 BUBBLER P O
# 2 BUBBLER P O
# 1 BUBBLER P O
# 1 BUBBLER P MID
# 3 BUBBLER S O
# 2 BUBBLER S O
# 1 BUBBLER S O
# 1 BUBBLER S MID
THRUSTER P O
THRUSTER S O
BLOW OFF S O
BLOW-OFF P O
CH. 204 PORT BUBBLERS
CH 205 STBD BUBBLERS
CH. 206 THRUSTERS AND BLOW-OFFS
BOX-6 ENG ROOM
TB2
TB1-2
TB1-4
TB1-6
TB1-8
TB1-10
TB1-12
TB1-14
TB1-16
TB1-19
TB1-20
TB1-22
TB1-24
COMMON

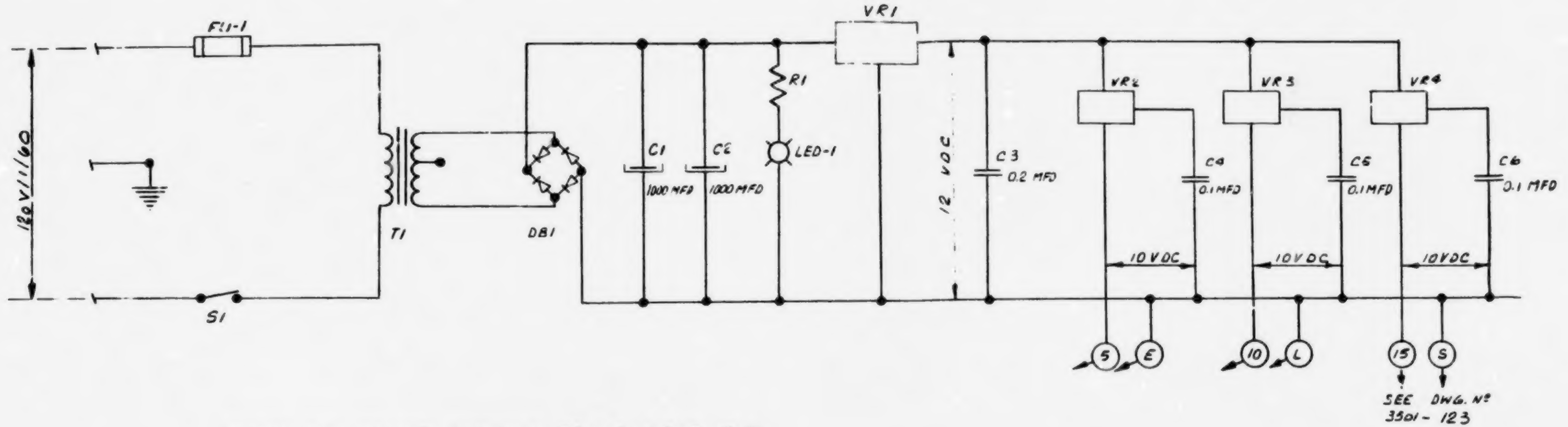
FOR NOTES: SEE DWG. Nº 3501-124

DATA GATHERING SYSTEM

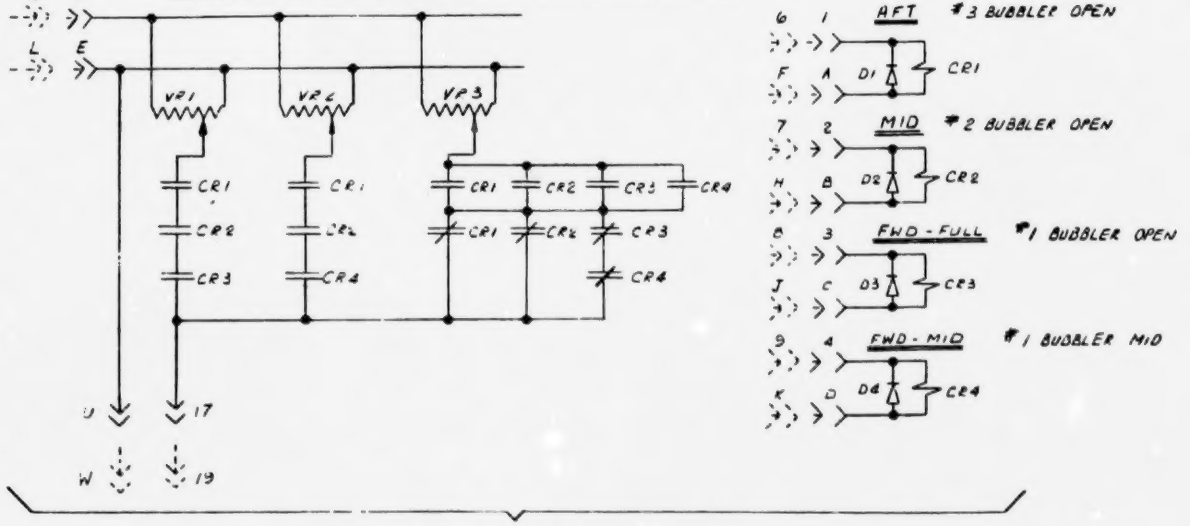
M. V. ARCTIC

FIG. 4.3

| | | | |
|---|---|---|---|
| **german — milne** INC.<br>Marine Transportation Consultants<br>Naval Architects<br>Montreal | NEXT HIGHER ASSY. | | DATE 8/1979 |
| | | | DRAWN BY |
| | TITLE SCHEMATIC – THRUSTER AND BLOW-OFF TRANSLATOR | | DWG. NO. 3501-510 |


FU-1
120V/1/60
S1
T1
DB1
C1
1000 MFD
C2
1000 MFD
R1
LED-1
VR1
12 VDC
C3
0.2 MFD
VR2
VR3
VR4
C4
0.1 MFD
C5
0.1 MFD
C6
0.1 MFD
10 VDC
10 VDC
10 VDC
5
E
10
L
15
S
SEE DWG. Nº
3501 - 123

BUBBLER VALVE POSITION TRANSLATOR CKT.


10
5
L
E
VR1
VR2
VR3
CR1
CR2
CR3
CR1
CR2
CR4
CR1
CR2
CR3
CR4
CR1
CR2
CR3
CR4
U
17
W
19
6
1
AFT
#3 BUBBLER OPEN
F
A
D1
CR1
7
2
MID
#2 BUBBLER OPEN
H
B
D2
CR2
8
3
FWD - FULL
#1 BUBBLER OPEN
J
C
D3
CR3
9
4
FWD - MID
#1 BUBBLER MID
K
D
D4
CR4

PORT & STBD IDENTICAL CIRCUITRY
STBD. TERM P'S SHOWN IN DOTTED LINES

NOTES:-

1 – NUMBERS ENCLOSED IN ◯ DENOTE DESTINATION POINTS.

2 – ⟫ DENOTE PLUG IN CONNECTOR'S

3 – TB1 IS MOUNTED ON THE BUBBLER VALVE POSITION TRANSLATOR ENCLOSURE

4 – TB2 IS MOUNTED IN THE MCR CONSOLE SEPARATELY

5 – ▭ DENOTES SHIP'S MCR CONSOLE TERMINAL BLOCKS.

DATA GATHERING SYSTEM
M.V. ARCTIC

FIG. 4.4

| | | |
|---|---|---|
| **german + milne** INC.<br>Marine Transportation Consultants<br>Naval Architects<br>Montreal | NEXT HIGHER ASSY. | DATE 8/1979 |
| | | DRAWN BY |
| | TITLE SCHEMATIC - BUBBLER TRANSLATOR | DWG. NO. 3501 - 511 |

# SECTION 5

# ENVIRONMENTAL SENSING INSTRUMENTATION

# Section 5: Environmental Instrumentation

- 5.1 Manual Circuits
    - 5.1.1 Circuit Details
- 5.2 Wind Speed and Direction
    - 5.2.1 Circuit Details
    - 5.2.2 Wind Vane
    - 5.2.3 Anemometer
    - 5.2.4 Synchro to Analogue Converter

## 5.1 Manual Circuits

Environmental measurements of Visibility, Cloud Cover, Ice Cover, Barometric Pressure, Air Temperature, and Relative Humidity can be manually entered into the system on channels 224 to 232, in box 7 on the bridge.

### 5.1.1 Circuit Details

Settings are made by switching along a resistor chain or adjusting a potentiometer, all of which share a 5V dc independent power supply (fig. 5.1). Most of the outputs go to amplifiers with a gain of 2 and reference of 0V to produce a 0 to +10V output range (fig. 5.2). Air temperature must cater for + and - settings (selected by a switch) so the amplifier for this signal has a differential input with a gain of 1 and a reference of +5V (fig. 5.3)

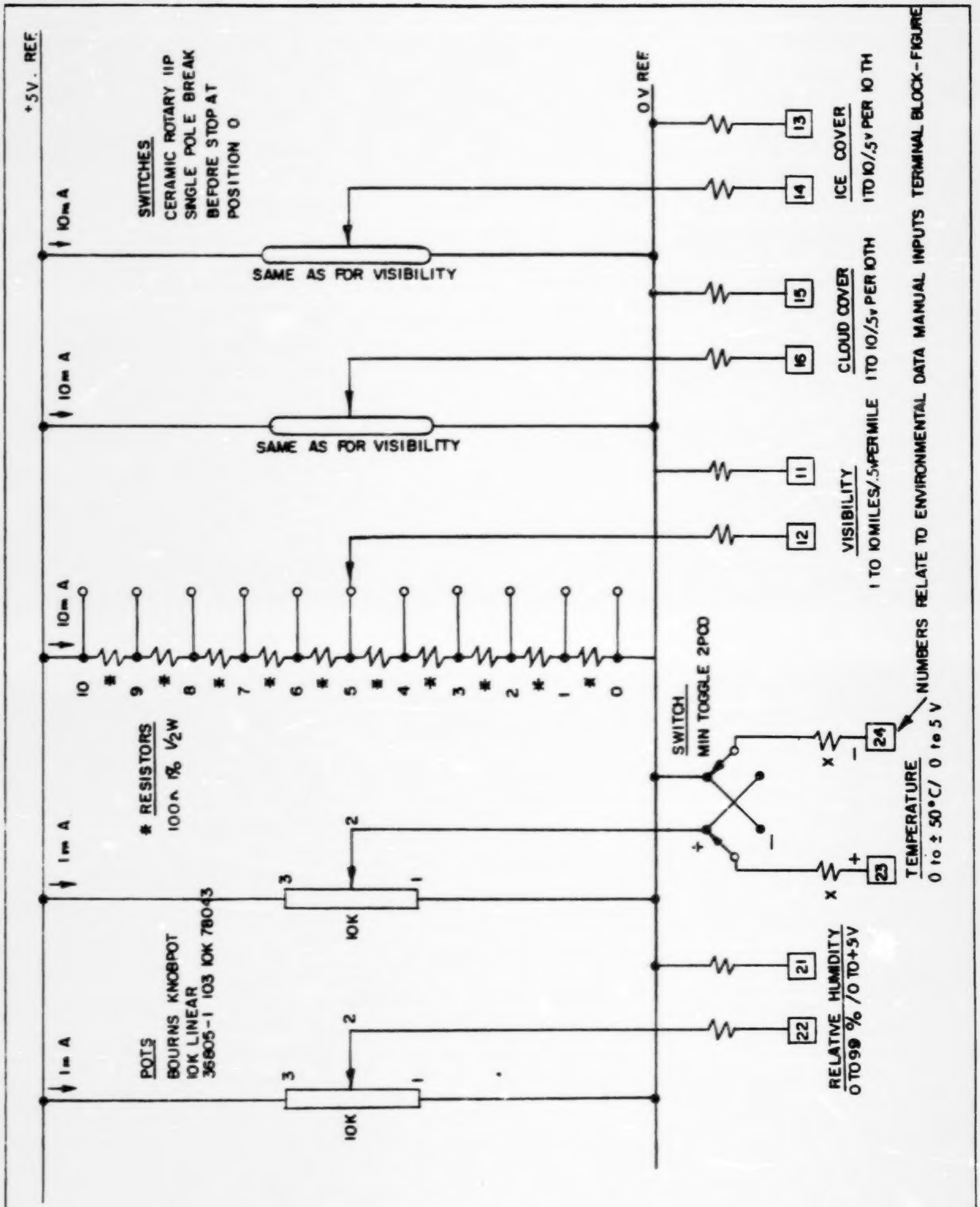

+5V. REF
SWITCHES
CERAMIC ROTARY 11P
SINGLE POLE BREAK
BEFORE STOP AT
POSITION 0
10mA
10mA
10mA
1mA
1mA
SAME AS FOR VISIBILITY
SAME AS FOR VISIBILITY
0 V REF
13
14
ICE COVER
1 TO 10/.5v PER 10 TH
15
16
CLOUD COVER
1 TO 10/.5v PER 10TH
11
12
VISIBILITY
1 TO 10MILES/.5v PER MILE
NUMBERS RELATE TO ENVIRONMENTAL DATA MANUAL INPUTS TERMINAL BLOCK-FIGURE
10
9
8
7
6
5
4
3
2
1
0
* RESISTORS
100Ω 1% 1/2W
SWITCH
MIN TOGGLE 2PCO
+
−
X
X
+
−
23
24
TEMPERATURE
0 to ± 50°C/ 0 to 5 V
POTS
BOURNS KNOBPOT
10K LINEAR
36805-1 103 10K 78043
3
2
1
10K
10K
21
22
RELATIVE HUMIDITY
0 TO 99 %/0 TO +5V

FIGURE 5.1a WIRING DIAGRAM, MANUAL INPUT CIRCUIT, ENVIRONMENTAL DATA

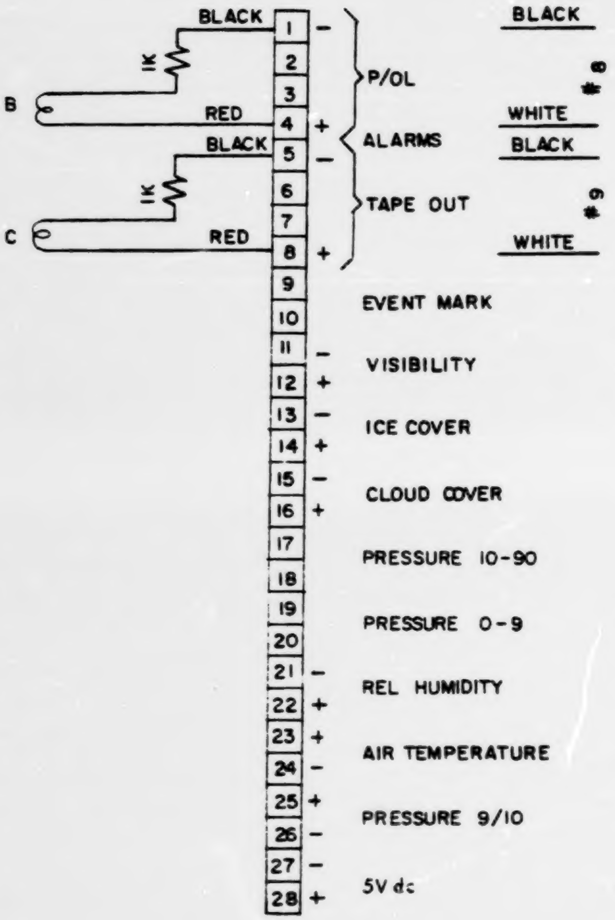

BLACK
IK
B
RED
BLACK
IK
C
RED
1 –
2
3
4 +
5 –
6
7
8 +
P/OL
ALARMS
TAPE OUT
BLACK
#8
WHITE
BLACK
#9
WHITE
9
10
EVENT MARK
11 –
12 +
VISIBILITY
13 –
14 +
ICE COVER
15 –
16 +
CLOUD COVER
17
18
PRESSURE 10-90
19
20
PRESSURE 0-9
21 –
22 +
REL HUMIDITY
23 +
24 –
AIR TEMPERATURE
25 +
26 –
PRESSURE 9/10
27 –
28 +
5V dc

FIGURE 5.1b TERMINAL BLOCK, MANUAL INPUT CIRCUITS, ENVIRONMENTAL DATA

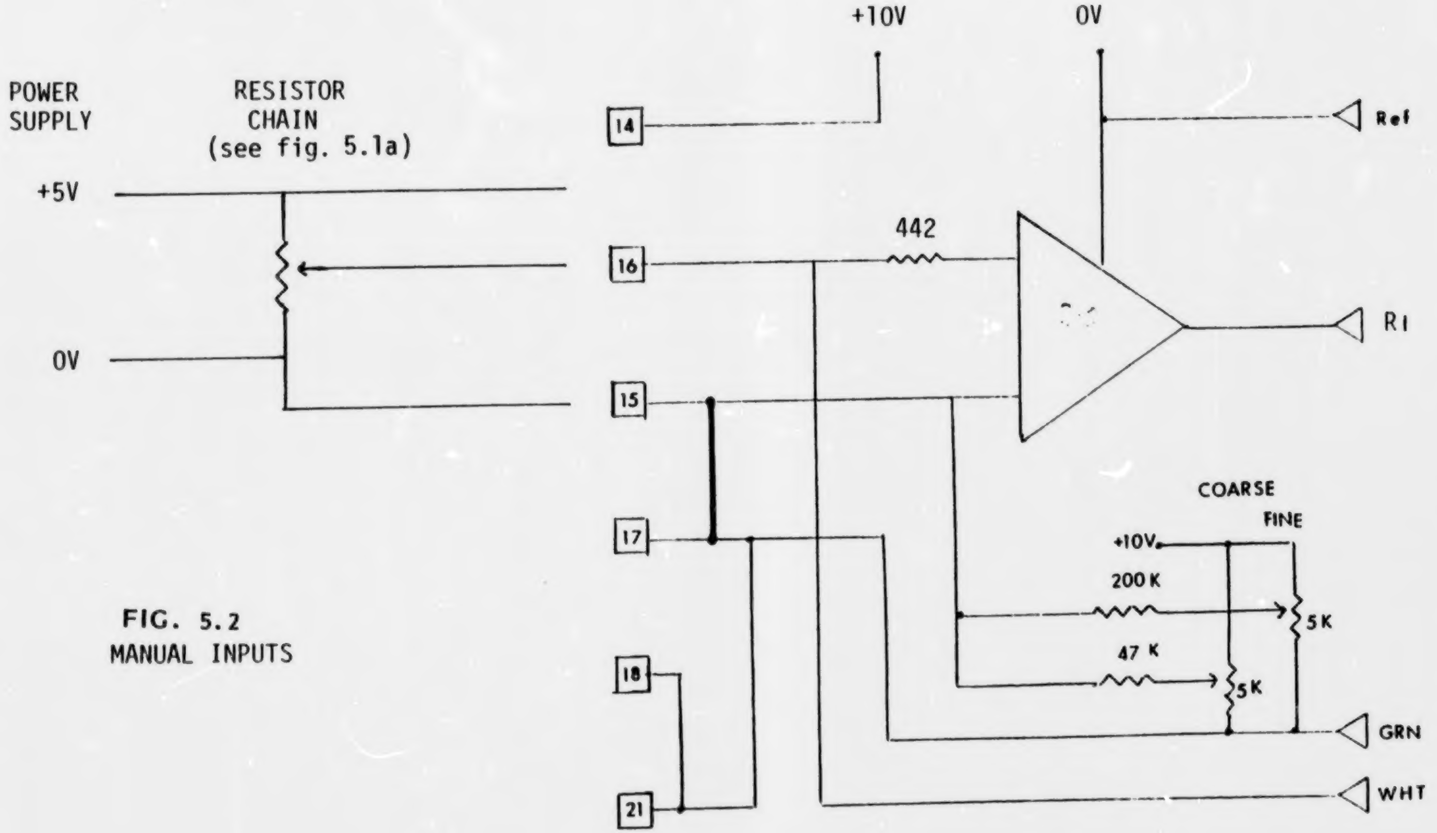

POWER SUPPLY
+5V
0V
RESISTOR CHAIN (see fig. 5.1a)
14
16
15
17
18
21
+10V
0V
442
Ref
R1
COARSE
FINE
+10V
200 K
47 K
5 K
5 K
GRN
WHT

FIG. 5.2
MANUAL INPUTS

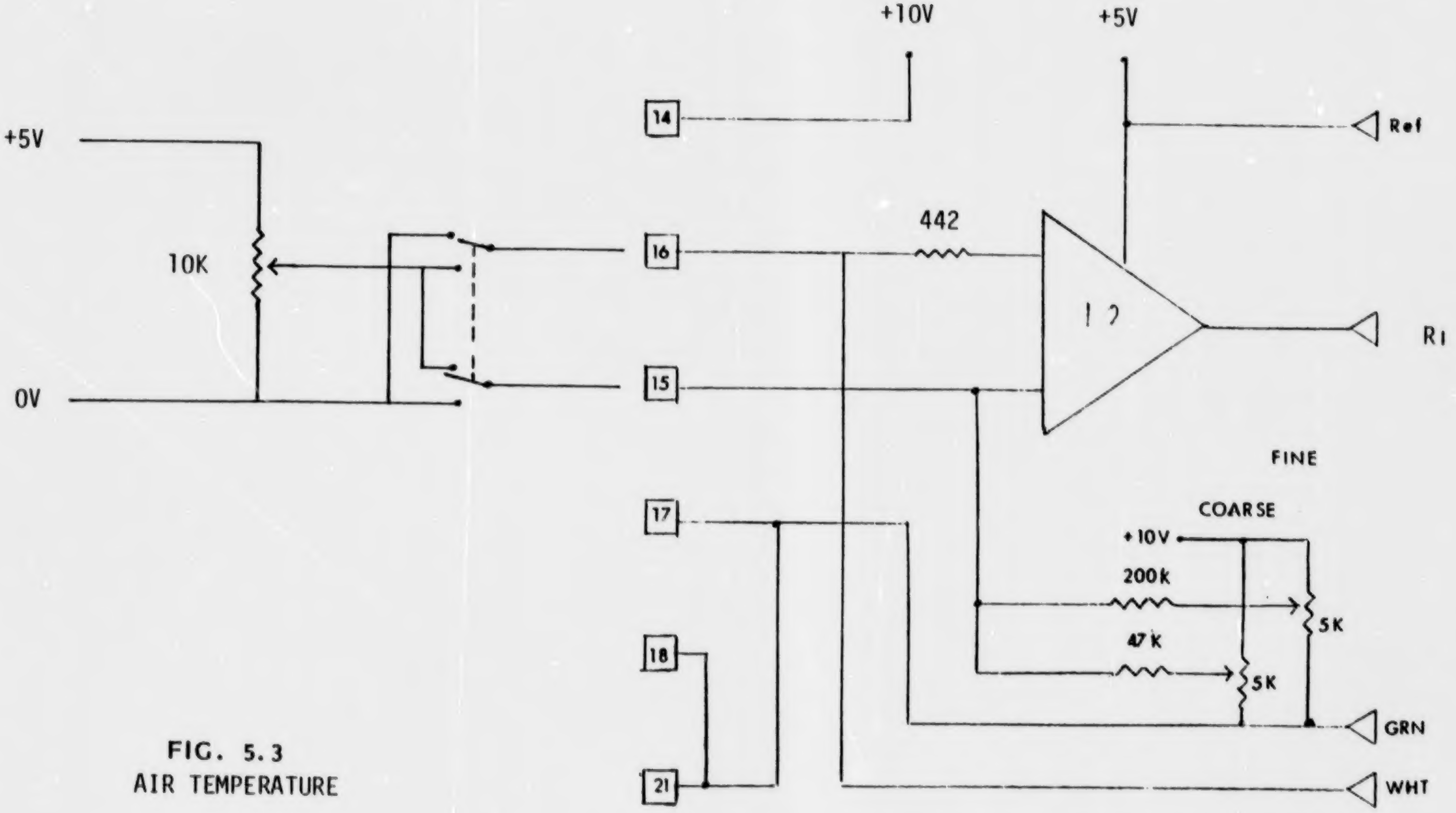

+10V
+5V
14
Ref
+5V
10K
16
442
I 2
RI
0V
15
FINE
COARSE
17
+10V
200k
5K
47K
5K
18
GRN
21
WHT

FIG. 5.3
AIR TEMPERATURE

## 5.2 Wind Speed and Direction

Wind speed and direction are obtained from the outputs of a conventional remote reading wind vane and anemometer supplied, and maintained, by the Atmospheric Environment Service (fig. 5.4). Connections are made at the back of the indicators on the navigator's console: the speed output going to channel 233 while the direction signal goes through a synchro to analogue converter to channel 234 (fig. 5.5).

### 5.2.1 Circuit Details

The anemometer gives an output of 0.07 volts/knot. This goes through to the amplifier with a gain of 1 and reference of +5V to give outputs of +5V to +10V corresponding to 0 knots to 70 knots (fig. 5.6).

The synchro to analogue converter gives outputs from -10V to +10V and is connected to an amplifier with a gain of 0.5 and reference of +5V (fig. 5.7).

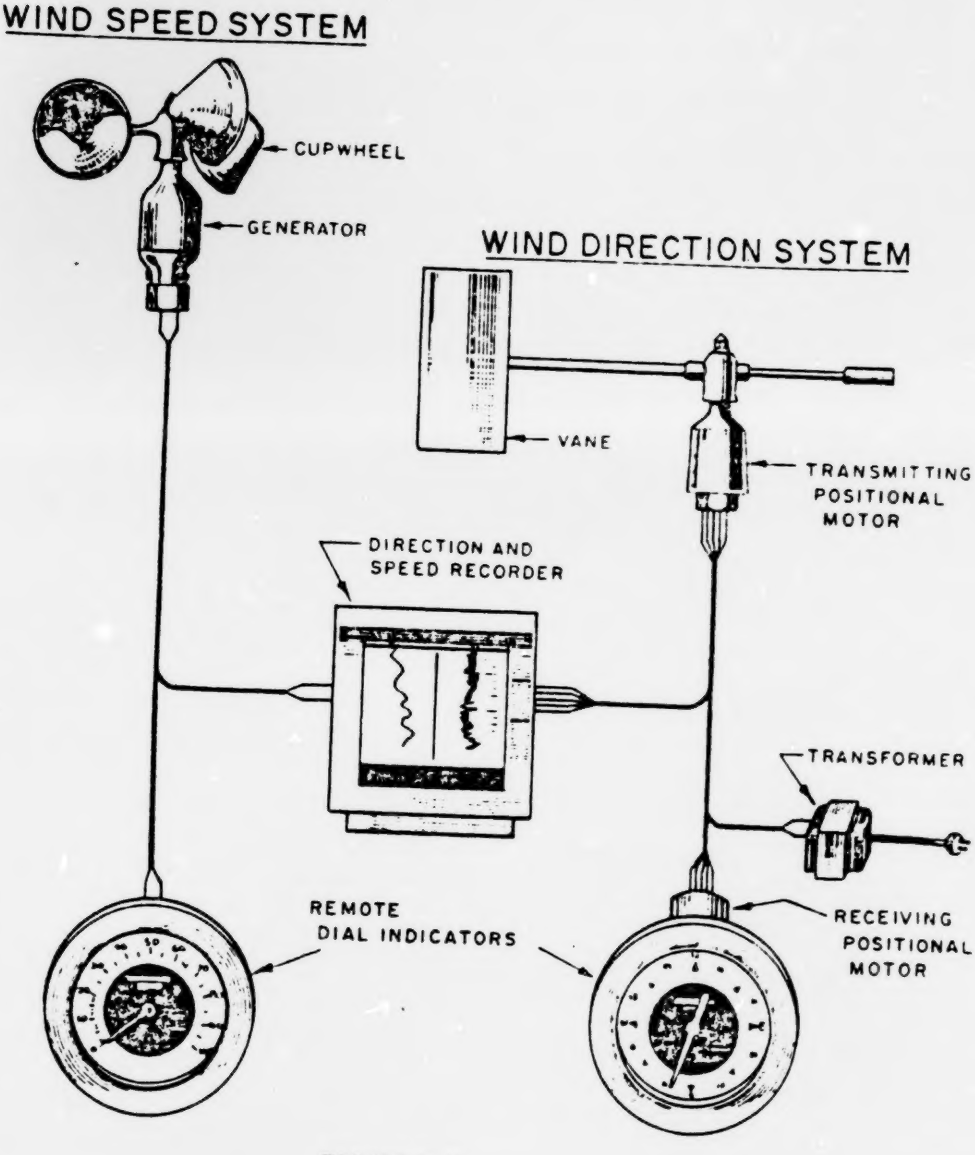
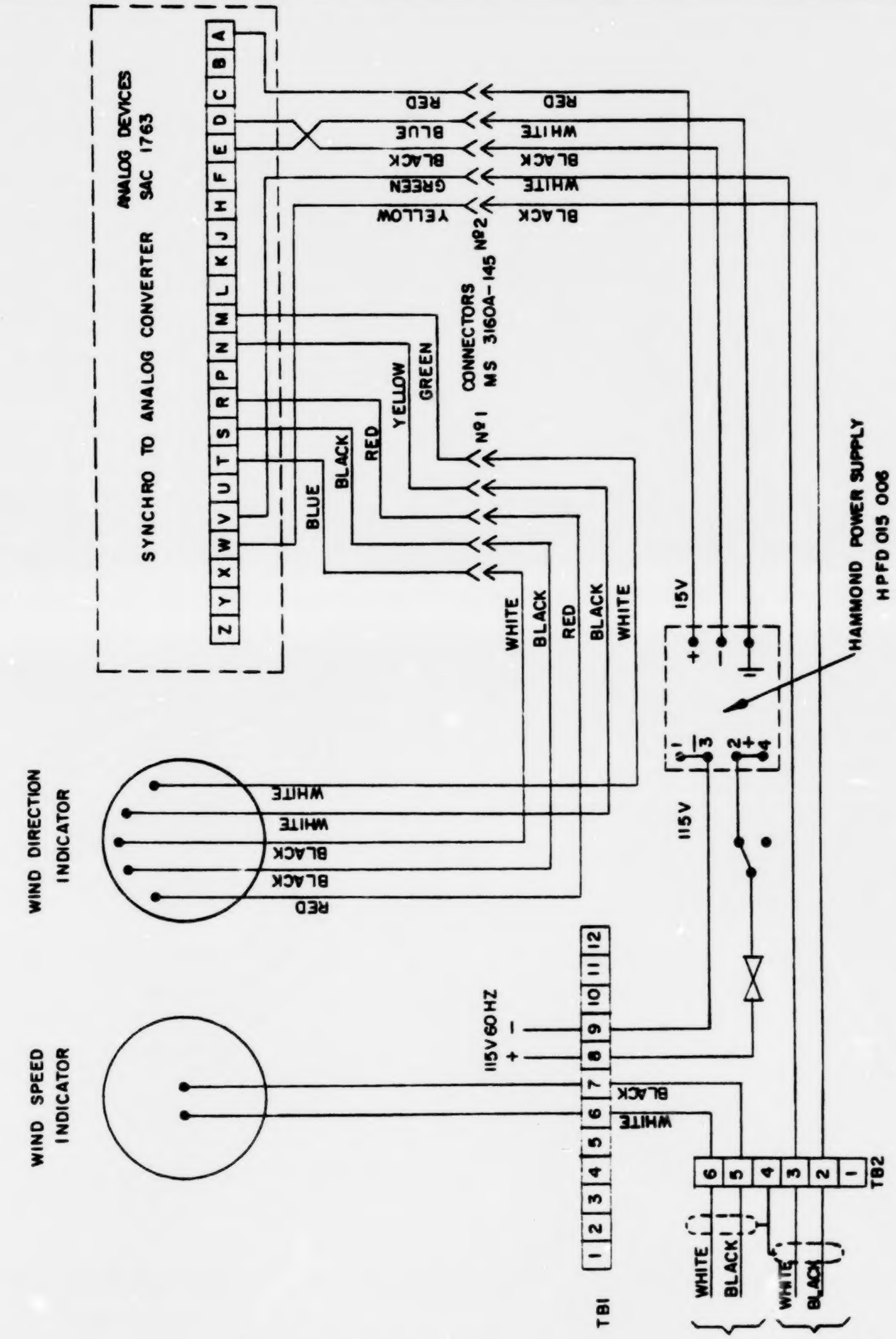

WIND SPEED SYSTEM
CUPWHEEL
GENERATOR
WIND DIRECTION SYSTEM
VANE
TRANSMITTING POSITIONAL MOTOR
DIRECTION AND SPEED RECORDER
TRANSFORMER
REMOTE DIAL INDICATORS
RECEIVING POSITIONAL MOTOR

FIGURE 5.4



ANALOG DEVICES
SYNCHRO TO ANALOG CONVERTER SAC 1763
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
RED
BLUE
BLACK
GREEN
YELLOW
RED
WHITE
BLACK
WHITE
BLACK
CONNECTORS
MS 3160A-145 Nº2
Nº1
BLUE
BLACK
RED
YELLOW
GREEN
WHITE
BLACK
RED
BLACK
WHITE
15V
+
−
HAMMOND POWER SUPPLY
HPFD 015 006
1
3
2
4
115V
WIND DIRECTION INDICATOR
WHITE
WHITE
BLACK
BLACK
RED
WIND SPEED INDICATOR
115V60HZ
+
−
1
2
3
4
5
6
7
8
9
10
11
12
TB1
BLACK
WHITE
6
5
4
3
2
1
TB2
WHITE
BLACK
WHITE
BLACK

FIGURE 5.5 CONNECTIONS, WIND DIRECTION AND WIND SPEED

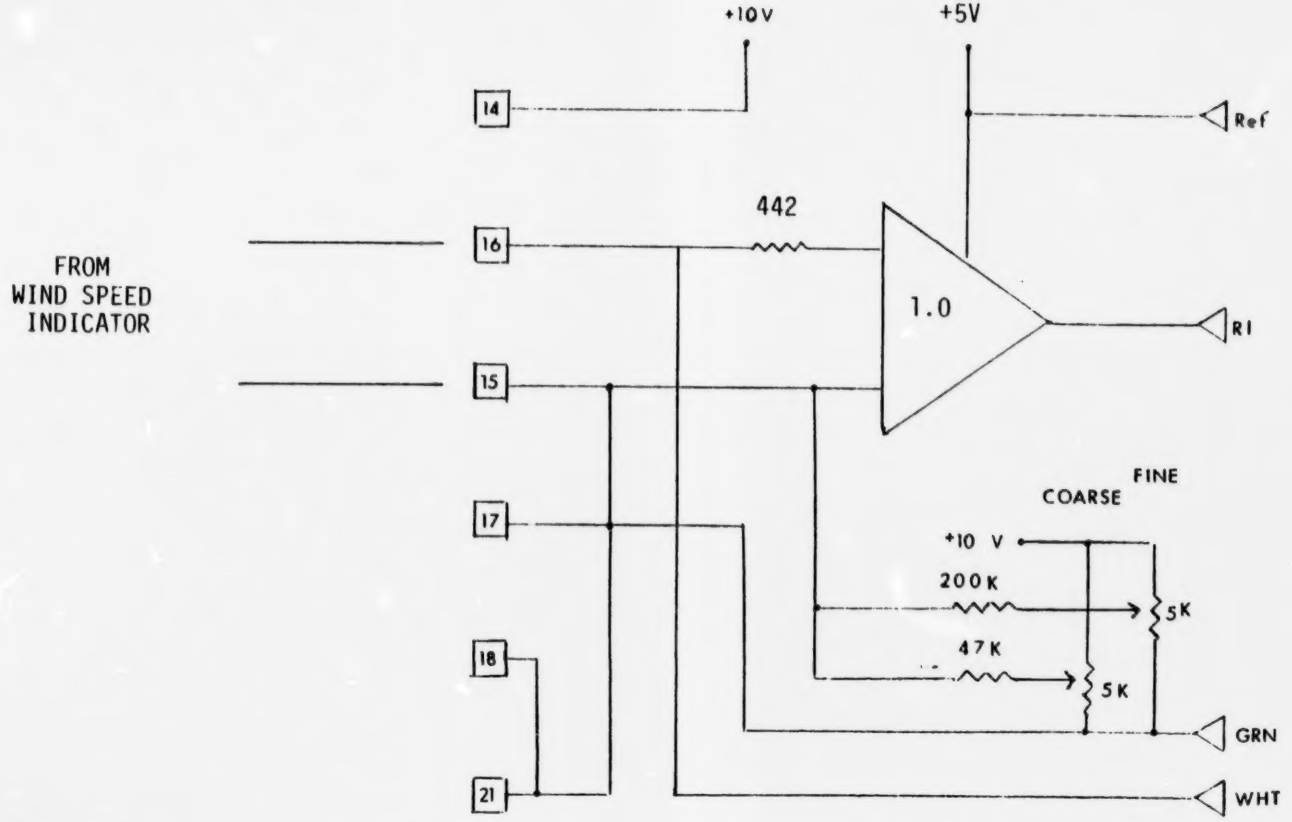

+10V
+5V
14
Ref
442
16
FROM
WIND SPEED
INDICATOR
1.0
RI
15
COARSE
FINE
17
+10 V
200K
5K
47K
5K
18
GRN
21
WHT

FIG. 5.6
WIND SPEED

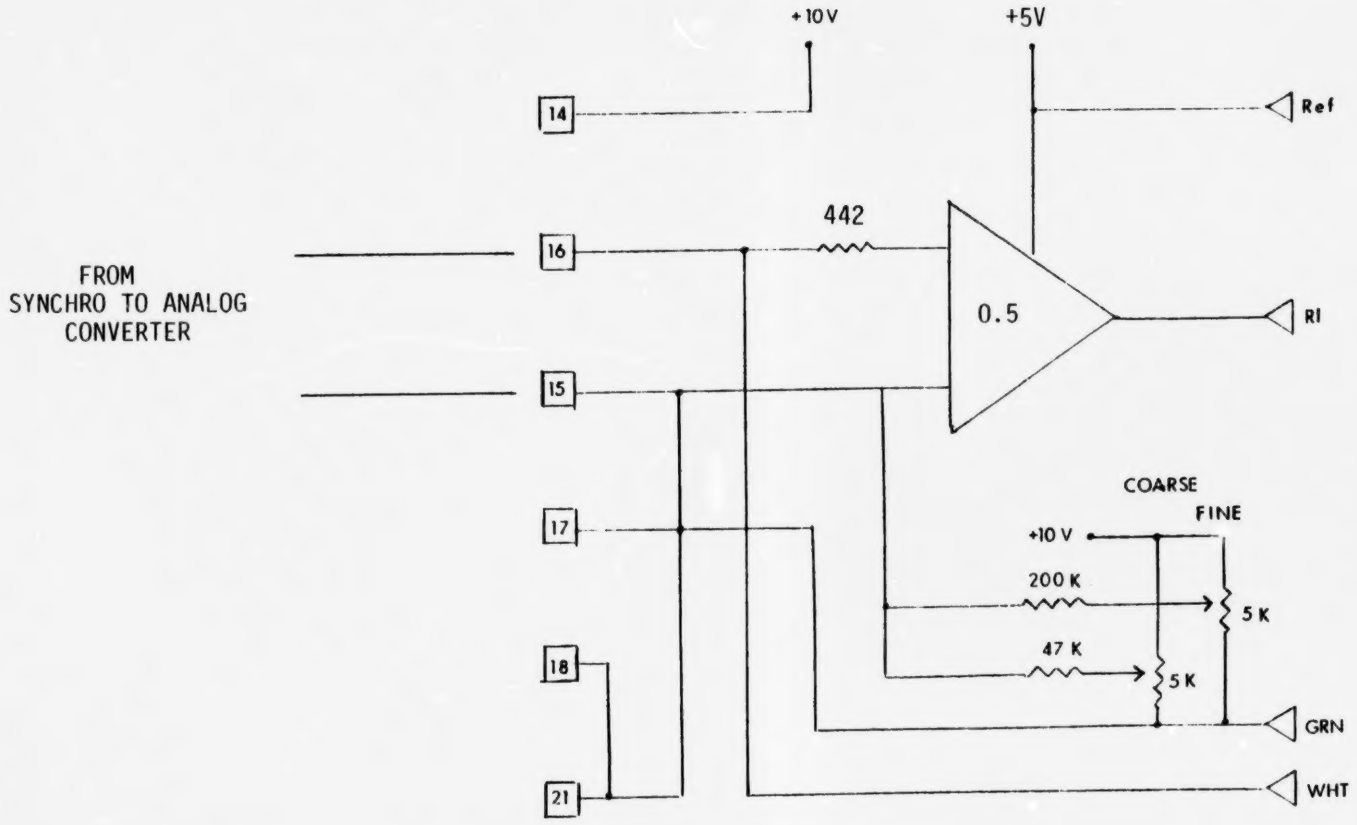

+10V
+5V
14
Ref
442
16
FROM
SYNCHRO TO ANALOG
CONVERTER
0.5
RI
15
COARSE
FINE
+10 V
17
200 K
5 K
47 K
5 K
18
GRN
21
WHT

FIG. 5.7
WIND DIRECTION

# SECTION 6

# SUBJUNCTION BOXES AND DATA BUS

# Section 6: Subjunction Boxes and Data Bus

- 6.1 Master Cards
  - 6.1.1 Circuit Details
  - 6.1.2 Master Card Problems
  - 6.1.3 Test Point Readings
- 6.2 Data Bus
  - 6.2.1 Use of Bus Lines
- 6.3 Subjunction Boxes
  - 6.3.1 Power Supplies
  - 6.3.2 Wiring Diagrams

## 6.1 Master Cards

The master card provides the link between the data bus and the amplifier cards in its bin: receiving address and command signals from the interface and generating the necessary signals for the amplifier cards. Differential analog bus drivers on the master cards send the amplifier card outputs through onto the bus. A set of test points and switches are also carried on the master card (fig. 6.1).

### 6.1.1 Circuit Details

Address and command lines come in on pins F to T and through an RC filtering and diode protection network. The card address is amplified by IC1 producing $CA_0$ signals and inverted by IC14 producing $CA_0$ signals. The bin address is programmed on the master card by the setting of the 5 switches that select whether a direct or inverted (by IC2) signal goes to IC3. This responds when that bin is addressed and when clocked by the address enable signal EN produces the card enable signal CE.

The R/P signal is amplified by noninverting and inverting buffers (contained in ICs 1 and 2 respectively) to produce the MA and MA signals for the amplifier cards. A CLR signal on pin U enables the oscillator (IC6, C4, R19, R21) producing a 70KHz clock signal for the auto zero circuit. Oscillator output is buffered by IC5 to produce the ZC signal. Operation of the ZERO CHECK Push-button enables the oscillator in the absence of a CLR signal. Outputs Z and Z are no longer used so transistors Q1 and Q6 and associated circuitry is now obsolete.

Analogue signals from the amplifier cards are buffered by the op. amp. IC8 and go direct, or through inverter IC9 to the

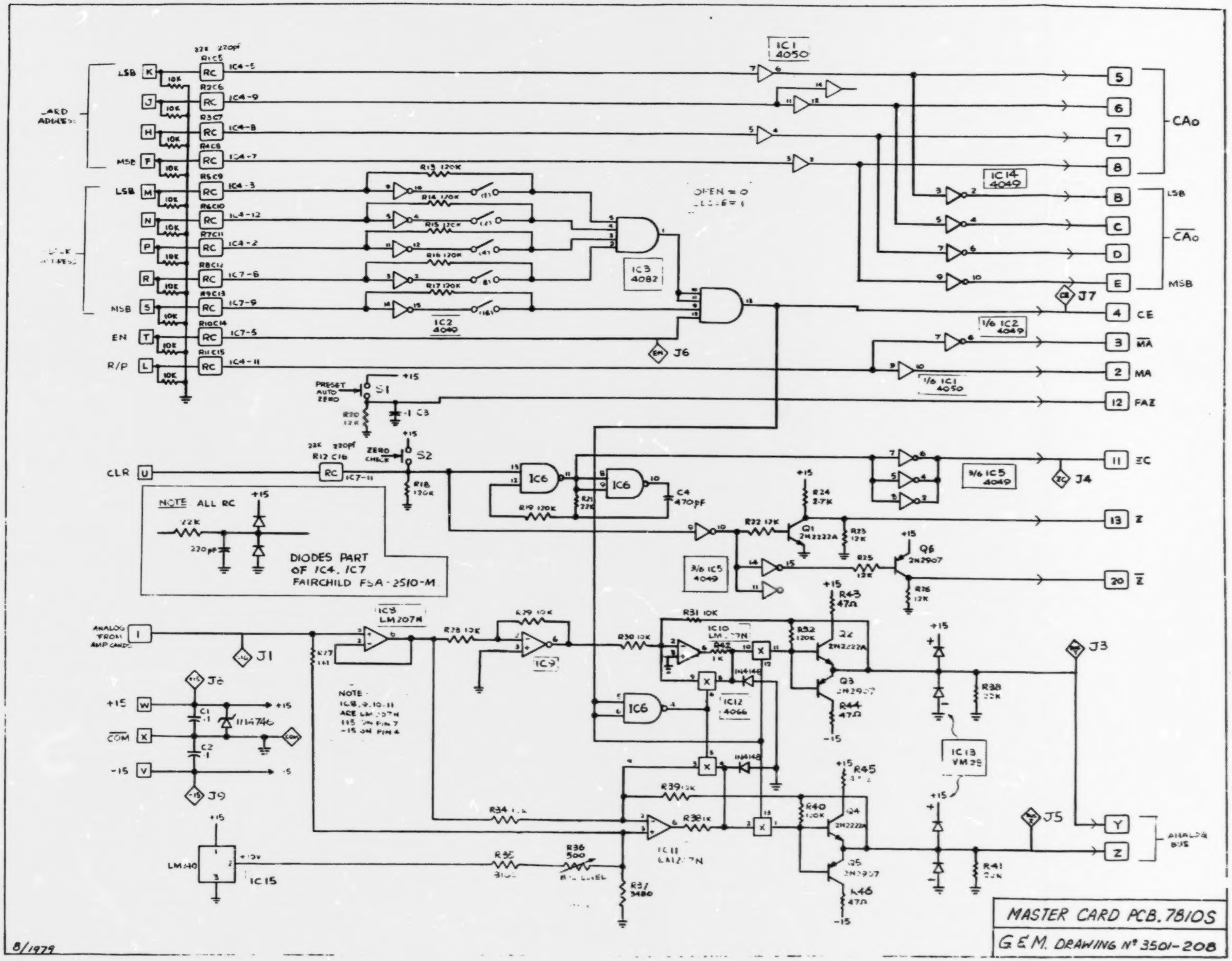

MASTER CARD PCB.7810S
G.E.M. DRAWING N° 3501-208
8/1979
CARD ADDRESS
LSB
MSB
EN
R/P
CLR
ANALOG FROM AMP CARDS
IC1 4050
IC14 4049
IC2 4049
IC3 4082
IC5 4049
IC6
IC8 LM207N
IC9
IC10
IC11
IC12 4066
IC13 VM28
IC15
LM140
OPEN = 0
CLOSE = 1
CAo
CE
MA
FAZ
ZC
Z
ANALOG BUS
J1
J3
J4
J5
J6
J7
J8
J9
S1
S2
PRESET AUTO ZERO
ZERO CHECK
C3
C4 470pF
1N4746
1N4148
Q1 2N2222A
Q2 2N2222A
Q3 2N2907
Q4 2N2222A
Q5 2N2907
Q6 2N2907
R36 500
NOTE ALL RC
22K
220pF
DIODES PART OF IC4, IC7 FAIRCHILD FSA-2510-M
NOTE: IC8, 9, 10, 11 ARE LM207N +15 ON PIN 7 -15 ON PIN 4
+15
-15
COM

FIGURE 6.1
MASTER CARD
CIRCUIT DIAGRAM

bus driver circuits. In the 'Y' bus driver the op. amp. (IC 10) has its positive input grounded so re-inverts the signal and controls the push-pull transistors Q2 and Q3 so the original signal appears on bus Y. In the 'Z' bus driver, the positive input of the op. amp. (IC11) is held at +5V by the resistor network R35, R36 and R37. The actual voltage may be adjusted using the BUS LEVEL Pot. R36. The effect of the inverting op. amp. is now to 'rotate' the signal about the =5V level. Bus Z thus carries a 'mirror image' of the original signal but still within the voltage range 0V to +10V.

The +5V from the resistor network is also taken through a 1M resistor to the input line. This holds the input to IC8 at +5V when there is no signal from the amplifier cards but, because of the high resistance, does not affect signals when they are switched through from the amplifier cards.

The card enable signal CE is used to switch the drivers on and off utilizing the gates in IC12. When the drivers are off Bus Y is connected to ground through R38 and to the input of op. amp. (IC10) through R31. The op. amp. holds the input at virtual zero and so Bus Y sits at 0V. Bus Z is connected to ground through R41 and to the input of op. amp. (IC11) through R39. The op. amp. holds that input at approx +5V so R39 and R41 constitute a voltage divider and approx. +2V appears at Bus Z.

### 6.1.2 Master Card Problems

Situations may be encountered in which all channels in one bin give incorrect printout. This is usually due to one faulty amplifier card and occurs because all the amplifier cards in a bin share a common line to the master card signal input. Thus, one faulty card will drag down the line and prevent any signals going through. This problem can also occur with a good amplifier card if the amplifier input is open circuit for any reason. In this condition, the amplifier output drives negative until stopped by the diode D3, usually at about -0.7 volts. The gates (IC4) (that supposedly only switch the output through to the master card when that amplifier card is addressed) cannot cope with negative voltages and so the -0.7 volts appears on the shared line to the master card.

All master cards share the one data bus for sending data back to the interface. Consequently, one faulty or unpowered master card can drag down the whole bus and prevent any sensible data being obtained at the interface. The problem of unpowered master cards is catered for by using a spare line on the bus to link relays in each box powered from the +15V supply to each master card. Any loss of power would cause the relay to drop out and the 'Invalid Data' Alarm on the interface to sound. A faulty master card can also drag down the bus but, in this case, will only be detected by measuring the bus voltages.

The 'cascade' aspect of the above faults whereby one bad amplifier card can drag down the whole bin, and one bad master card can drag down the whole bus is an unfortunate feature of the system. It should be emphasized that the occurrence of these faults is not always apparent simply by looking at the printed output in the laboratory. However, satisfactory operation can be achieved by regularly checking the voltage levels on the master card test points.

Checking the ZC test point on a master card with a logic probe should show a 'low' level, going 'high' once a minute if 'auto' zero is switched on at the interface. Pushing Zero Check should produce a pulse output on ZC. If ZC stays 'high' permanently, try replacing the master card. If ZC is still 'high', the problem is with an amplifier card loading the ZC line so monitor ZC while pulling amplifier cards until the correct logic level is obtained.

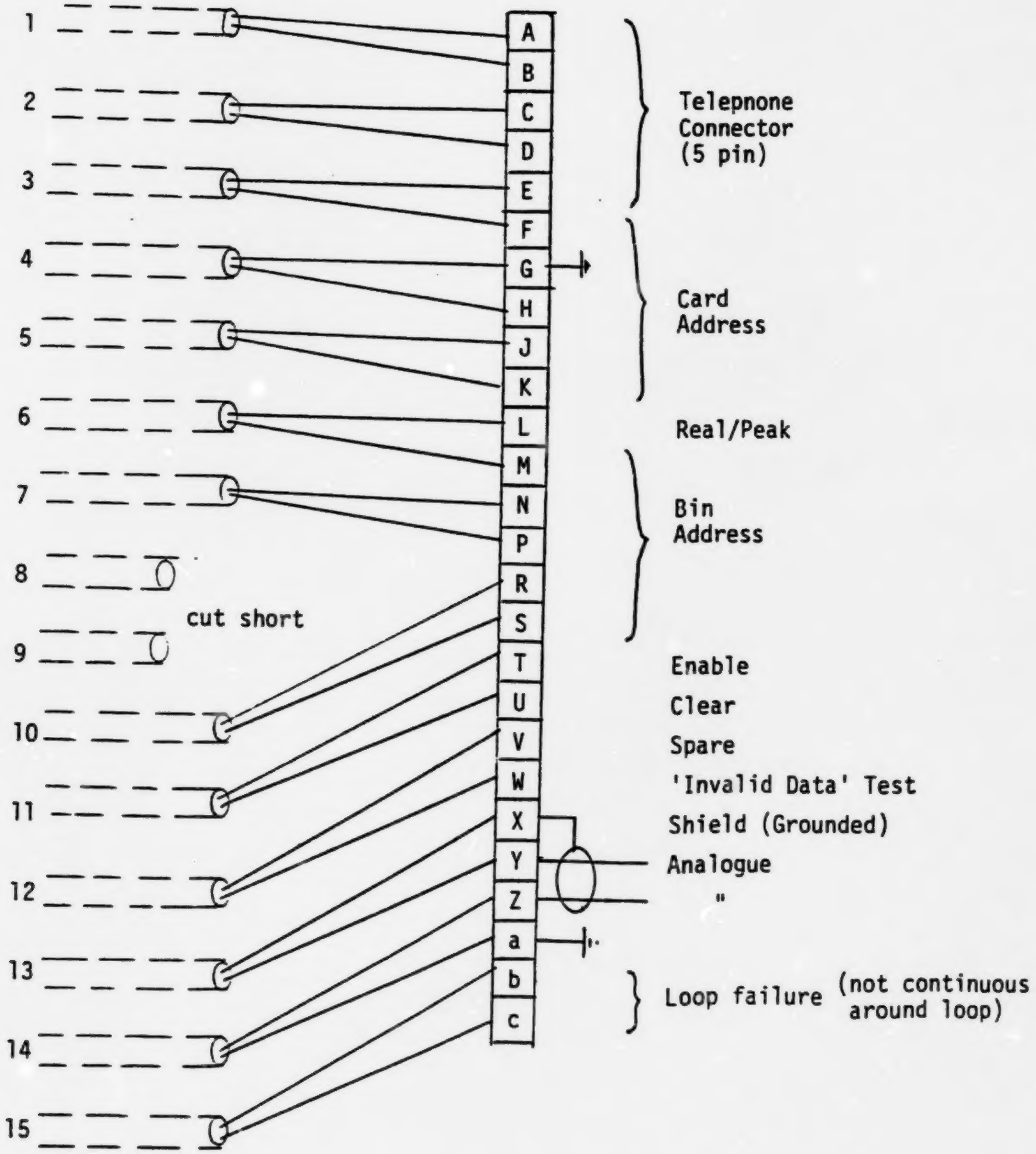
If ZC stays low and pushing Zero Check doesn't produce pulses, the cause is probably IC5 (4049) on the master card.

### 6.1.3 Correct Master Card Test Point Readings

| | |
|---|---|
| Signal In | sits at +4.5 volts, changes when cards being addressed<br>if near zero indicates one or more faulty amplifier cards |
| ZC | sits at logic 0<br>shows pulses when 'Zero Check' button depressed |
| EN | pulses |
| CE | sits at logic 0<br>goes to logic 1 when Master Card addressed |
| +15 | +15 volts with respect to 'common' |
| -15 | -15 volts with respect to 'common' |
| Common | Ground (0 volts) |
| Bus Y | sits at 0 volts |
| Bus Z | sits at 1.0 to 2.5 volts depending on the number of master cards connected to the bus.<br>if zero indicates a master card somewhere in the system is faulty |

## 6.2 Data Bus (Fig. 6.2)

The data bus forms a loop round the ship connecting all the subjunction boxes and the interface. Consequently, a single break in the bus will not cause any loss of data as there is still a route round the rest of the bus from any box back to the interface. The bus consists of an armoured cable containing 15 shielded twisted pairs, only 13 of which are used. All lines are continuous round the bus except the 'loop failure' lines 'b' and 'd' which are broken at a terminal box in the forepeak (port side) and joined to each other. The 'loop failure' alarm tests for a continuous circuit round the loop, through all the boxes, to the terminal box on line b and back again on line d. Resistance of the lines round the entire loop is about 9 OHMS. Breaks in the lines generally occur where the cables are soldered onto the plug conections at the subjunction boxes.



Main Bus

1
2
3
4
5
6
7
8
9
cut short
10
11
12
13
14
15
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
a
b
c
Telepnone Connector (5 pin)
Card Address
Real/Peak
Bin Address
Enable
Clear
Spare
'Invalid Data' Test
Shield (Grounded)
Analogue
"
Loop failure (not continuous around loop)

FIG. 6.2

## 6.3 Subjunction Boxes

The subjunction boxes are all water-tight instrument enclosures and house up to 3 bins of amplifier cards, together with their associated master card and power supply. To remove a bin chassis first remove all the circuit cards, then undo the mounting screws at the rear and the front sides. The bin should then come forward as far as the wiring allows.

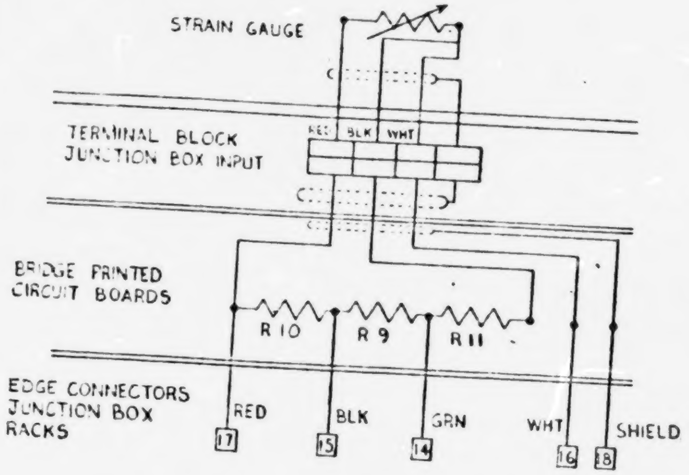
### 6.3.1 Power Supplies

The ±15V supply for each bin is provided by a Lambda LND-X-152 Dual Output Regulated Power Supply. This has a current rating of 2A at 50°C. Relays are connected to all the power supplies (0 to +15V side) and all the contacts are connected in series through line W of the data bus. Failure of any power supply will cause its relay to drop out so breaking the circuit and triggering the 'Invalid Data' Alarm at the Interface.

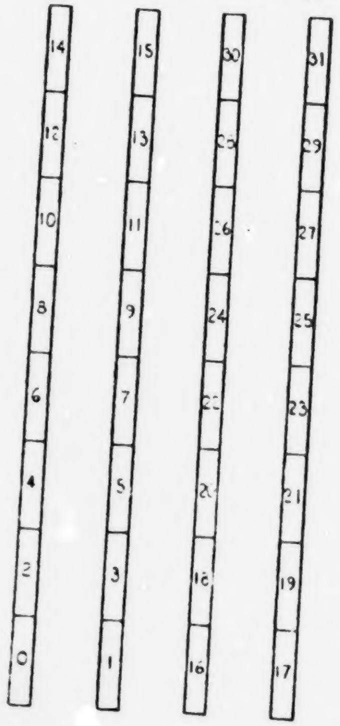
### 6.3.2 Wiring Diagrams

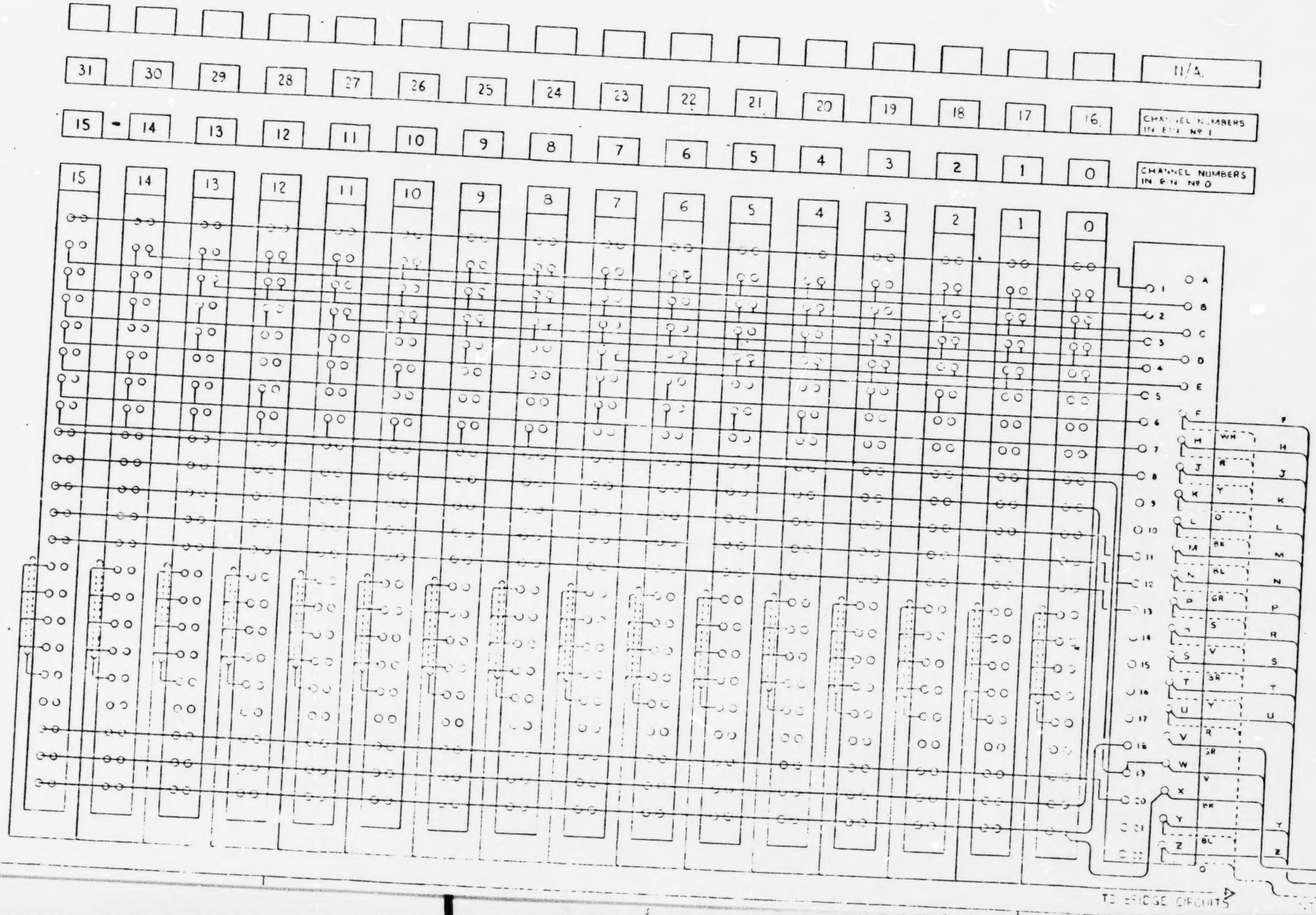
Wiring diagrams for all the boxes are shown in figs. 6.3 to 6.9.

## TYPICAL
## STRAIN GAUGE CONNECTIONS

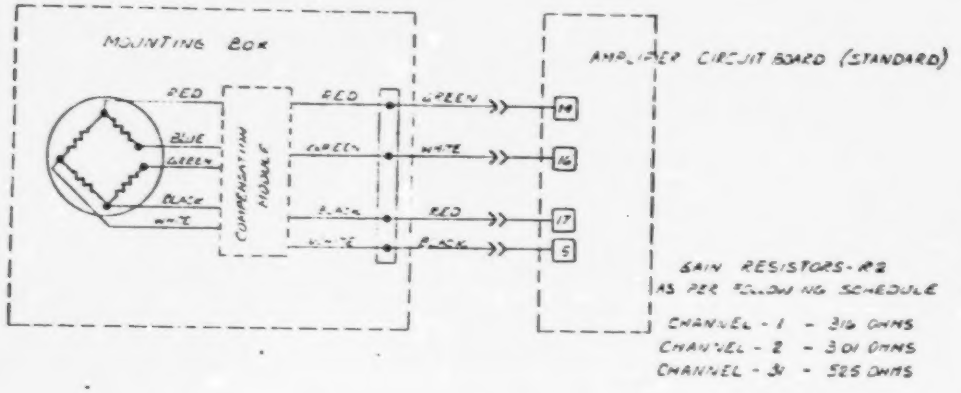

STRAIN GAUGE
TERMINAL BLOCK
JUNCTION BOX INPUT
RED
BLK
WHT
BRIDGE PRINTED
CIRCUIT BOARDS
R 10
R 9
R 11
EDGE CONNECTORS
JUNCTION BOX
RACKS
RED
BLK
GRN
WHT
SHIELD
17
15
14
16
18

## BRIDGE CIRCUITS
## LAYOUT BY CHANNEL Nº


14
12
10
8
6
4
2
0
15
13
11
9
7
5
3
1
30
28
26
24
22
20
18
16
31
29
27
25
23
21
19
17

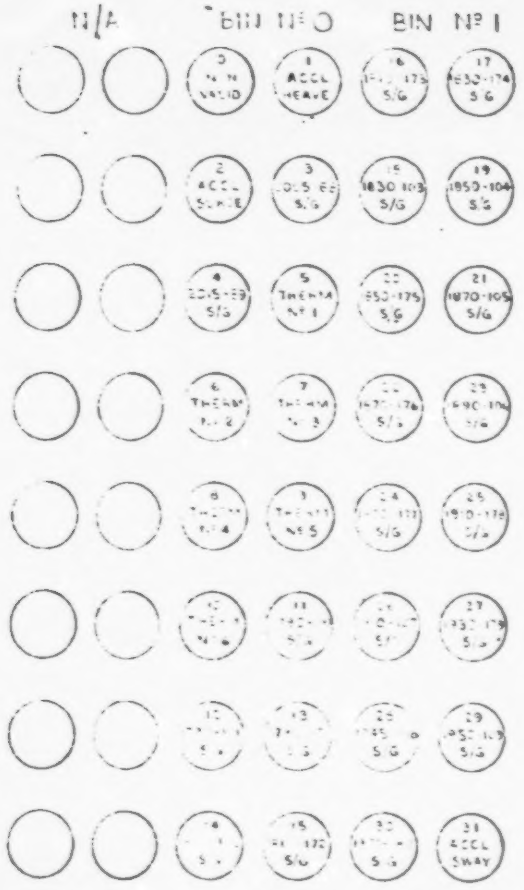

N/A.
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
CHANNEL NUMBERS
IN BIN Nº 1
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
CHANNEL NUMBERS
IN BIN Nº 0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
WH
R
Y
O
BK
BL
GR
S
V
GR
Y
R
GR
V
BK
BL
TO BRIDGE CIRCUITS

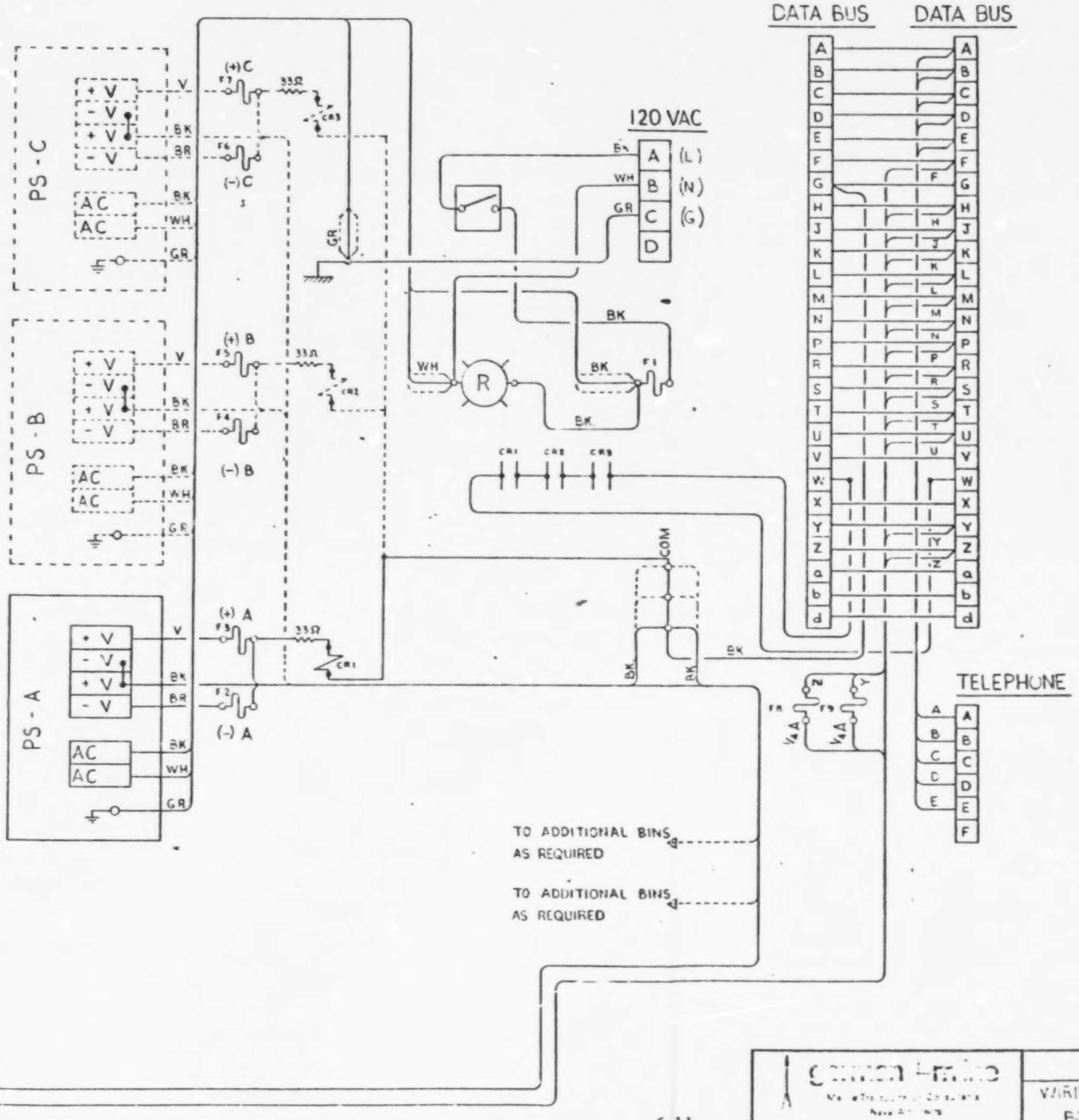
CONNECTIONS FOR CHANNELS Nos 1, 2, & 31


MOUNTING BOX
RED
BLUE
GREEN
BLACK
WHITE
COMPENSATION MODULE
RED
GREEN
BLACK
WHITE
GREEN
WHITE
RED
BLACK
AMPLIFIER CIRCUIT BOARD (STANDARD)
14
16
17
5

GAIN RESISTORS - R2
AS PER FOLLOWING SCHEDULE
CHANNEL - 1 - 316 OHMS
CHANNEL - 2 - 301 OHMS
CHANNEL - 31 - 525 OHMS

ENTRY GLAND LAYOUT BY
CHANNEL NUMBER
OUTSIDE VIEW


N/A
BIN No 0
BIN No 1
0
NON VALID
1
ACCL HEAVE
16
S/G
17
S/G
2
ACCL SURGE
3
S/G
18
1830-103
S/G
19
1850-104
S/G
4
S/G
5
THERM No 1
20
1850-175
S/G
21
1870-105
S/G
6
THERM No 2
7
THERM No 3
22
S/G
23
S/G
8
THERM No 4
9
THERM No 5
24
S/G
25
1910-176
S/G
10
THERM No 6
11
S/G
27
S/G
12
13
S/G
28
S/G
29
S/G
14
15
S/G
30
S/G
31
ACCL SWAY

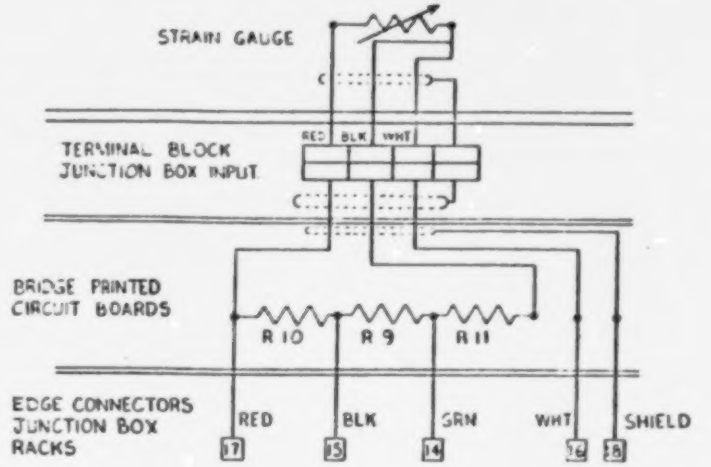

PS - C
PS - B
PS - A
+ V
- V
+ V
- V
AC
AC
V
BK
BR
BK
WH
GR
(+) C
F7
33Ω
CR3
F6
(-) C
(+) B
F5
33Ω
CR2
F4
(-) B
(+) A
F3
33Ω
CR1
F2
(-) A
GR
120 VAC
BK
WH
GR
A
B
C
D
(L)
(N)
(G)
R
WH
BK
BK
BK
F1
CR1
CR2
CR3
COM
BK
BK
BK
F8
F9
¼A
¼A
Z
Y
DATA BUS
DATA BUS
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
a
b
d
TELEPHONE
A
B
C
D
E
F
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED

NTER-BIN CONNECTIONS AS REQUIRED

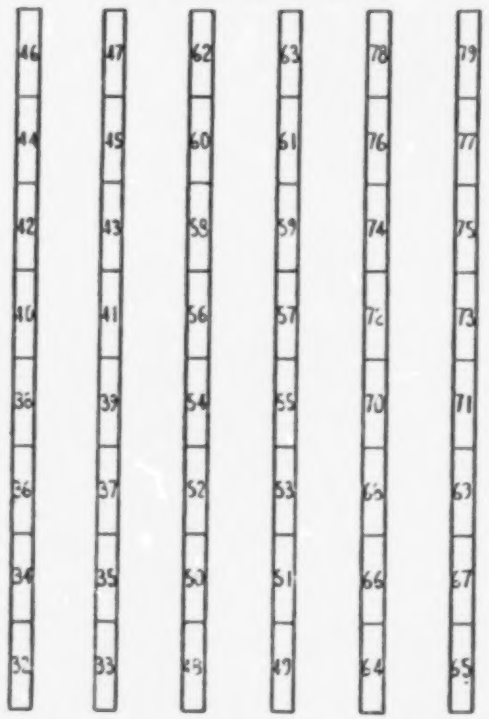
FIG. 6.3

| | | |
|---|---|---|
| German Hanke<br>Marine Transportation Consultants | M.V 'ARCTIC' | DATE : MARCH 197 |
| | WIRING DIAGRAM<br>BOX No 1 | DRAWN : W.A.R.M. |
| | | DWG No. 3501-201 |

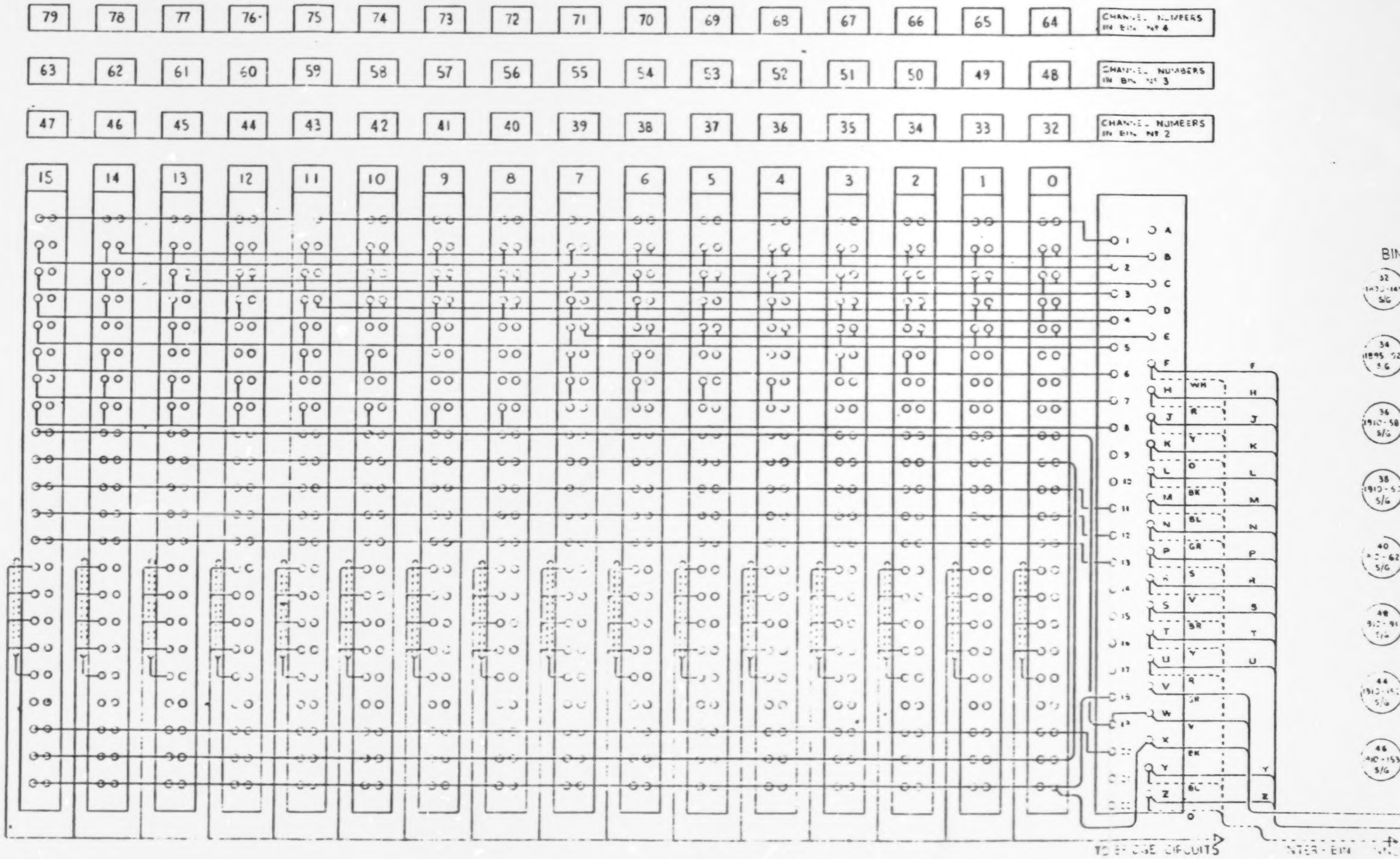
## TYPICAL
## STRAIN GAUGE CONNECTIONS


STRAIN GAUGE
RED
BLK
WHT
TERMINAL BLOCK JUNCTION BOX INPUT
BRIDGE PRINTED CIRCUIT BOARDS
R 10
R 9
R 11
EDGE CONNECTORS JUNCTION BOX RACKS
RED
BLK
GRN
WHT
SHIELD
17
15
14
16
18

## BRIDGE CIRCUITS
## LAYOUT BY CHANNEL Nº



| | | | | | |
|---|---|---|---|---|---|
| 46 | 47 | 62 | 63 | 78 | 79 |
| 44 | 45 | 60 | 61 | 76 | 77 |
| 42 | 43 | 58 | 59 | 74 | 75 |
| 40 | 41 | 56 | 57 | 72 | 73 |
| 38 | 39 | 54 | 55 | 70 | 71 |
| 36 | 37 | 52 | 53 | 68 | 69 |
| 34 | 35 | 50 | 51 | 66 | 67 |
| 32 | 33 | 48 | 49 | 64 | 65 |

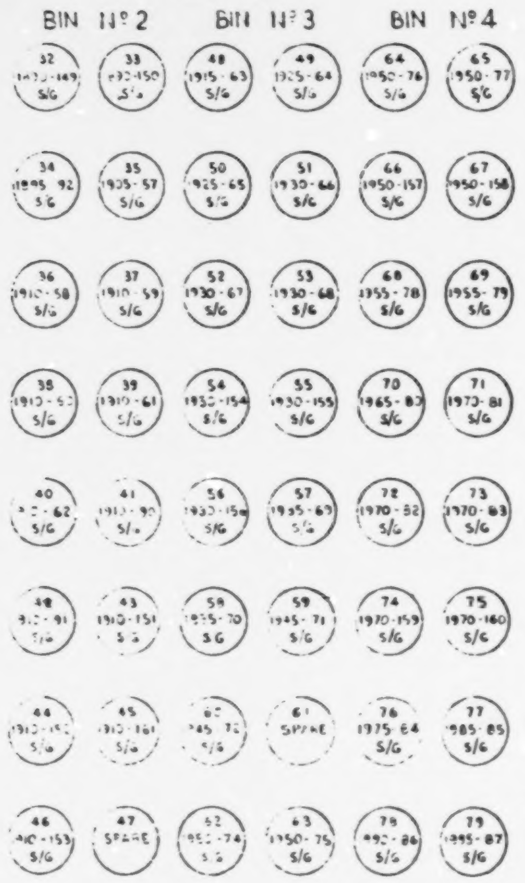


| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | CHANNEL NUMBERS IN BIN Nº 4 |
| 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | CHANNEL NUMBERS IN BIN Nº 3 |
| 47 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | CHANNEL NUMBERS IN BIN Nº 2 |
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
WH
R
Y
O
BK
BL
GR
S
V
SR
Y
R
GR
V
BK
BL
O
F
H
J
K
L
M
N
P
R
S
T
U
Y
Z
BIN
32
34
36
38
40
42
44
46
S/G
TO BRIDGE CIRCUITS
INTER-BIN

ENTRY GLAND LAYOUT BY CHANNEL NUMBER

OUTSIDE VIEW


BIN Nº 2
BIN Nº 3
BIN Nº 4
32 1910-149 S/G
33 1910-150 S/G
48 1915-63 S/G
49 1925-64 S/G
64 1950-76 S/G
65 1950-77 S/G
34 1995-92 S/G
35 1905-57 S/G
50 1925-65 S/G
51 1930-66 S/G
66 1950-157 S/G
67 1950-158 S/G
36 1910-58 S/G
37 1910-59 S/G
52 1930-67 S/G
53 1930-68 S/G
68 1955-78 S/G
69 1955-79 S/G
38 1910-60 S/G
39 1910-61 S/G
54 1930-154 S/G
55 1930-155 S/G
70 1965-80 S/G
71 1970-81 S/G
40 1910-62 S/G
41 1910-90 S/G
56 1930-156 S/G
57 1935-69 S/G
72 1970-82 S/G
73 1970-83 S/G
42 1910-91 S/G
43 1910-151 S/G
58 1935-70 S/G
59 1945-71 S/G
74 1970-159 S/G
75 1970-160 S/G
44 1910-152 S/G
45 1910-161 S/G
60 1945-72 S/G
61 SPARE
76 1975-84 S/G
77 1985-85 S/G
46 1910-153 S/G
47 SPARE
62 1950-74 S/G
63 1950-75 S/G
78 1990-86 S/G
79 1995-87 S/G

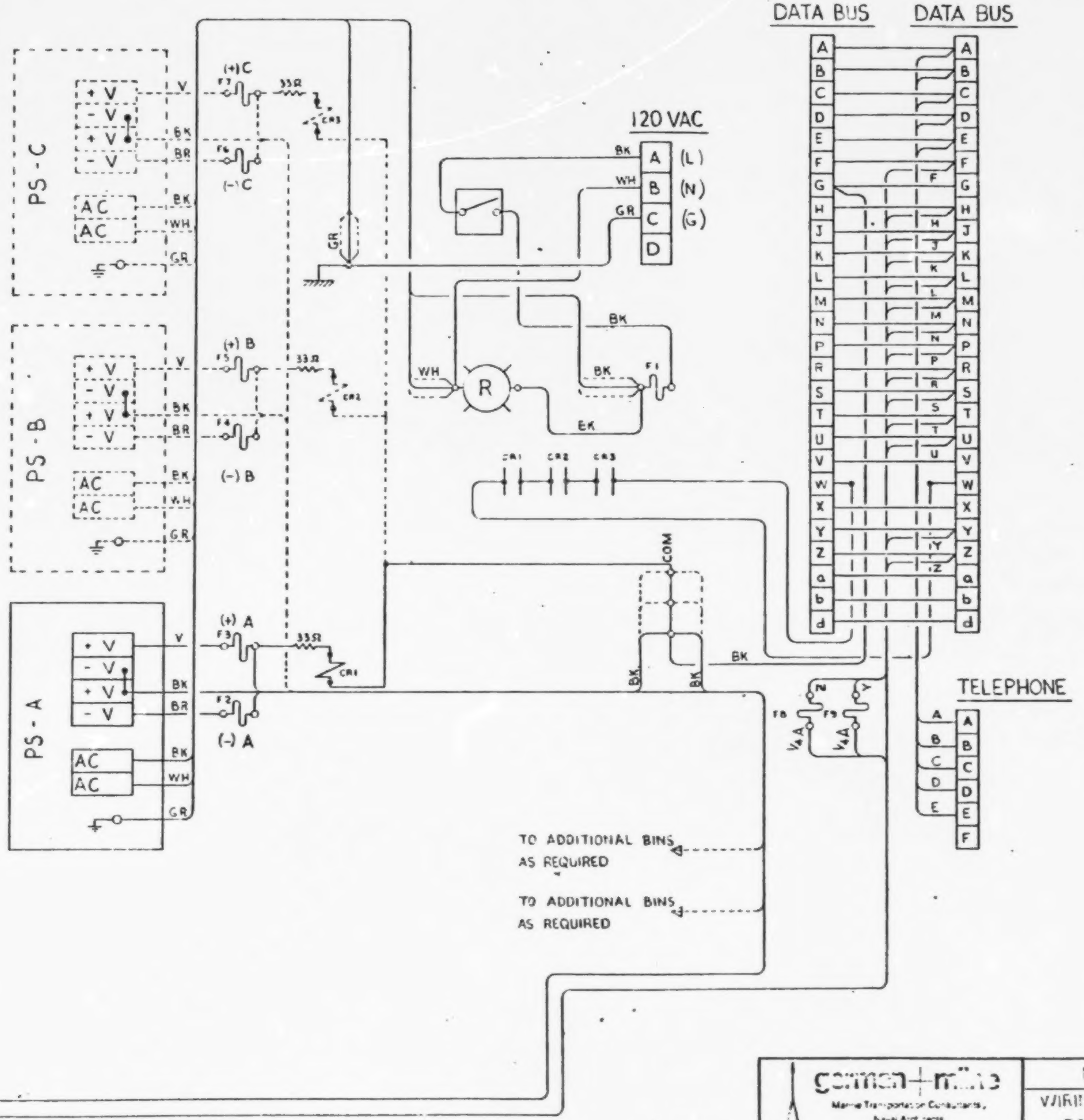
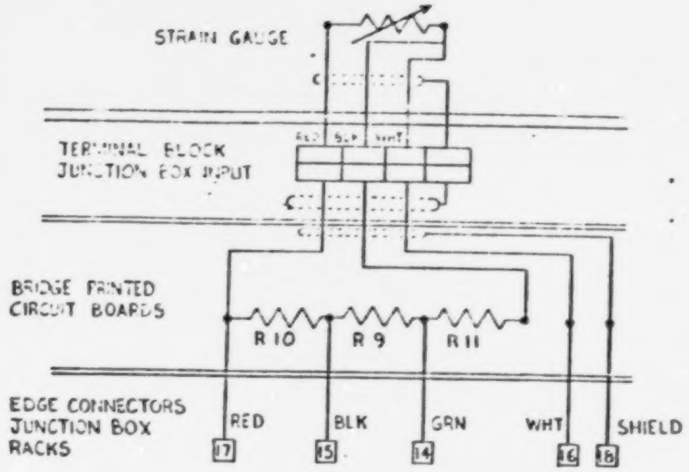

DATA BUS
DATA BUS
A B C D E F G H J K L M N P R S T U V W X Y Z a b d
120 VAC
BK A (L)
WH B (N)
GR C (G)
D
PS - C
PS - B
PS - A
+ V
- V
+ V
- V
AC
AC
V
BK
BR
WH
GR
(+) C
(-) C
(+) B
(-) B
(+) A
(-) A
F1 F2 F3 F4 F5 F6 F7
33Ω
CR1 CR2 CR3
R
COM
F8 F9
1/4 A
TELEPHONE
A B C D E F
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED
NTER-BIN NECTIONS AS REQUIRED

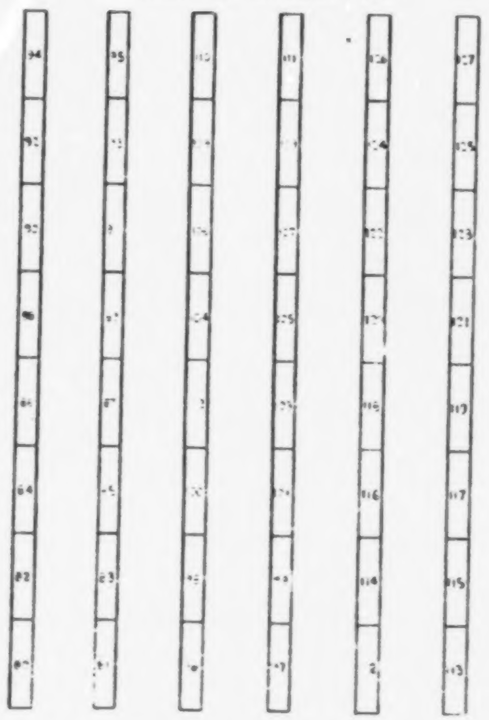
FIG. 6.4

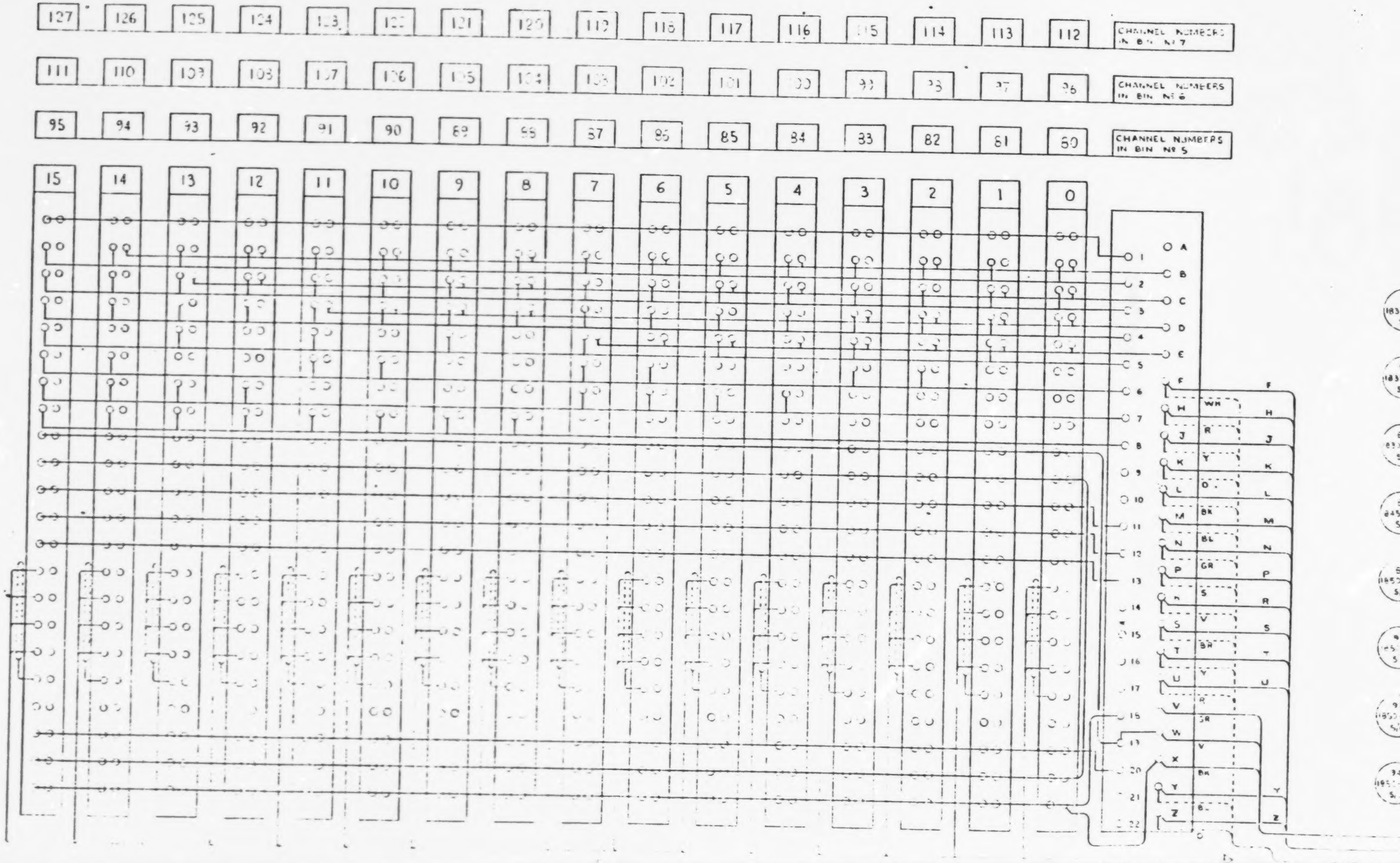
| german + milne<br>Marine Transportation Consultants, Naval Architects<br>Montreal | M.V 'ARCTIC' | DATE : MARCH 1979 |
|---|---|---|
| | WIRING DIAGRAM BOX Nº 2. | DRAWN : W A R M |
| | | DWG Nº 2501-202 |

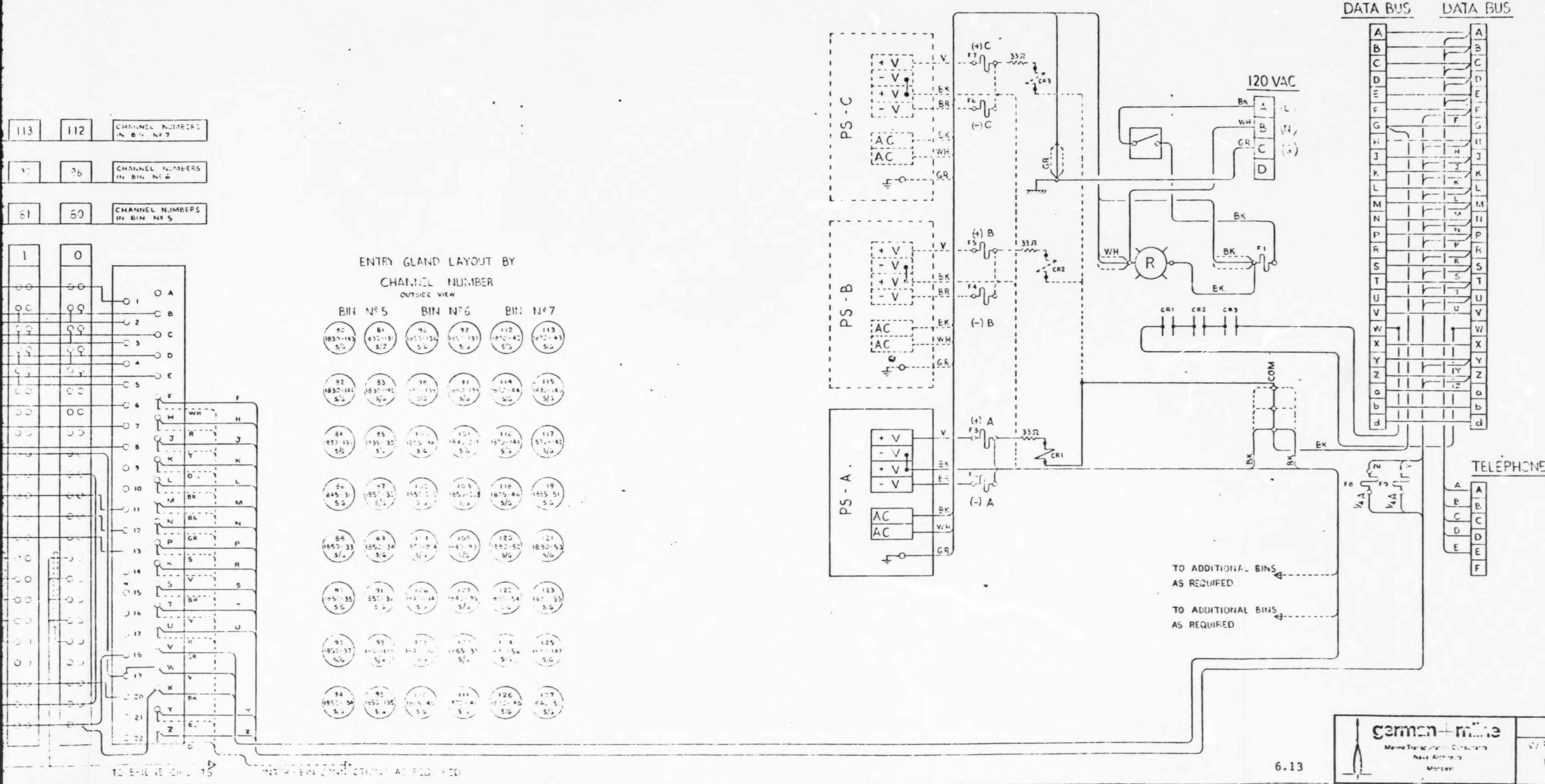
## TYPICAL
## STRAIN GAUGE CONNECTIONS


STRAIN GAUGE
TERMINAL BLOCK
JUNCTION BOX INPUT
BRIDGE PRINTED
CIRCUIT BOARDS
R 10
R 9
R 11
EDGE CONNECTORS
JUNCTION BOX
RACKS
RED
BLK
GRN
WHT
SHIELD
17
15
14
16
18

## BRIDGE CIRCUITS
## LAYOUT BY CHANNEL Nº




127
126
125
124
123
122
121
120
119
118
117
116
115
114
113
112
CHANNEL NUMBERS IN BIN Nº 7
111
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
CHANNEL NUMBERS IN BIN Nº 6
95
94
93
92
91
90
89
88
87
86
85
84
83
82
81
80
CHANNEL NUMBERS IN BIN Nº 5
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
WH
R
Y
O
BK
BL
GR
S
V
BR
Y
R
SR
V
BK
BL


113
112
CHANNEL NUMBERS IN BIN Nº 7
97
96
CHANNEL NUMBERS IN BIN Nº 6
81
80
CHANNEL NUMBERS IN BIN Nº 5
1
0
ENTRY GLAND LAYOUT BY CHANNEL NUMBER
OUTSIDE VIEW
BIN Nº 5
BIN Nº 6
BIN Nº 7
PS - C
PS - B
PS - A.
+ V
- V
AC
(+) C
(-) C
(+) B
(-) B
(+) A
(-) A
33Ω
CR1
CR2
CR3
120 VAC
R
COM
F1
F8
F9
¼ A
BK
WH
GR
BR
DATA BUS
DATA BUS
TELEPHONE
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED
TO BRIDGE CIRCUITS
INTER-BIN CONNECTIONS AS REQUIRED

6.13

german + milne
Marine Transportation Consultants
Naval Architects
Montreal

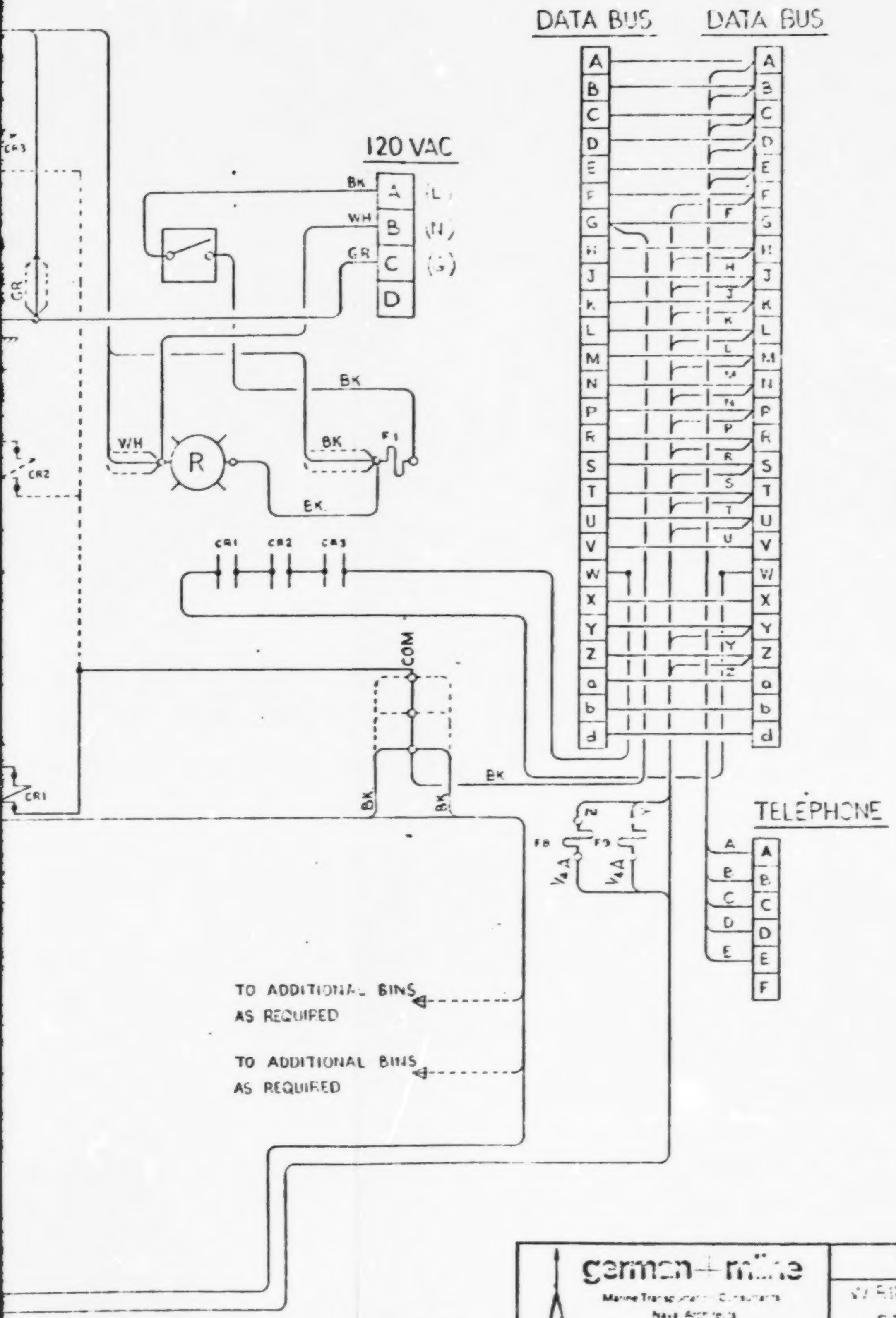

DATA BUS
DATA BUS
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
a
b
d
120 VAC
BK
WH
GR
A
B
C
D
(L)
(N)
(G)
CR3
CR2
CR1
GR
R
WH
BK
BK
F1
BK
CR1
CR2
CR3
COM
BK
BK
BK
F8
F9
1/4A
1/4A
TELEPHONE
A
B
C
D
E
F
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED

FIG. 6.5

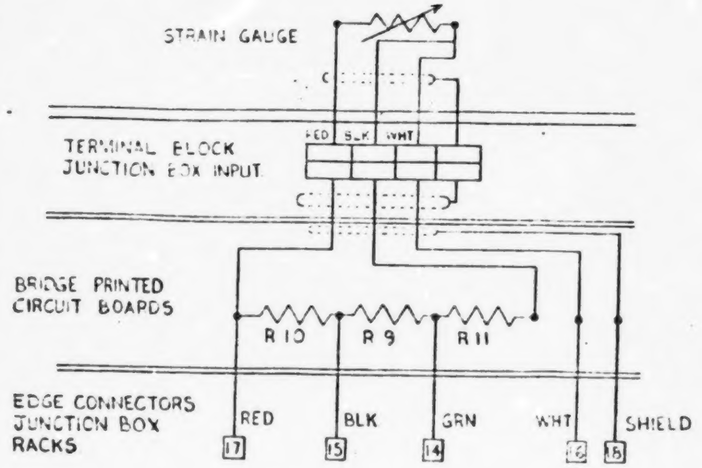
german + milne
Marine Transportation Consultants
Naval Architects
Montreal

M.V. 'ARCTIC'

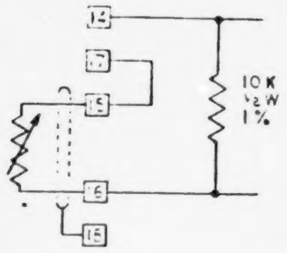
WIRING DIAGRAM
BOX Nº 3

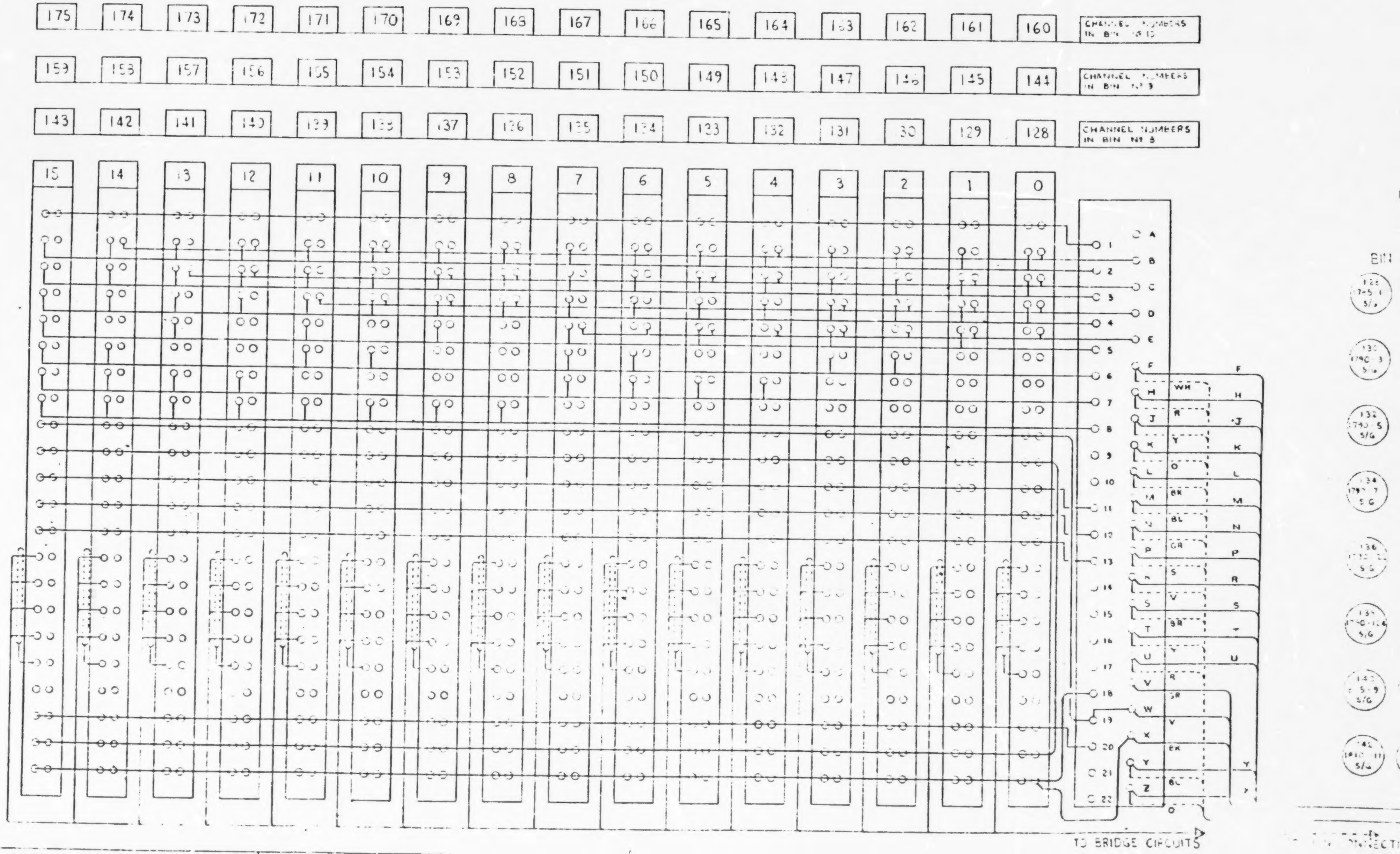
DATE : MARCH 19
DRAWN : W.A.R.M.
DWG Nº 3501-203

### TYPICAL STRAIN GAUGE CONNECTIONS

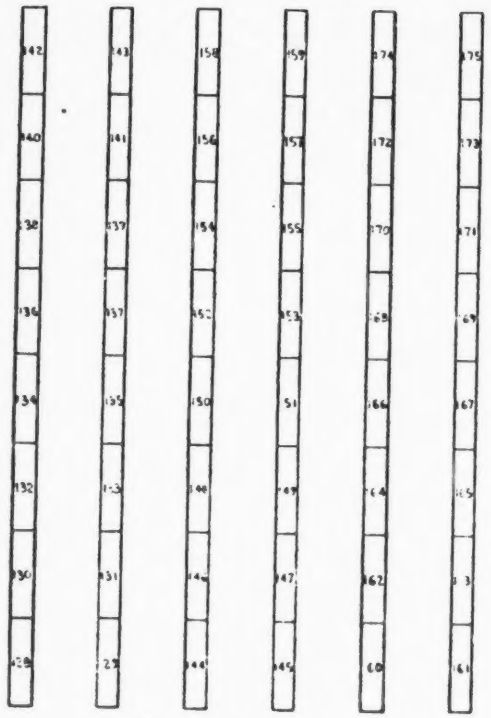

STRAIN GAUGE
RED
BLK
WHT
TERMINAL BLOCK JUNCTION BOX INPUT
BRIDGE PRINTED CIRCUIT BOARDS
R 10
R 9
R 11
EDGE CONNECTORS JUNCTION BOX RACKS
RED
BLK
GRN
WHT
SHIELD
17
15
14
12
16

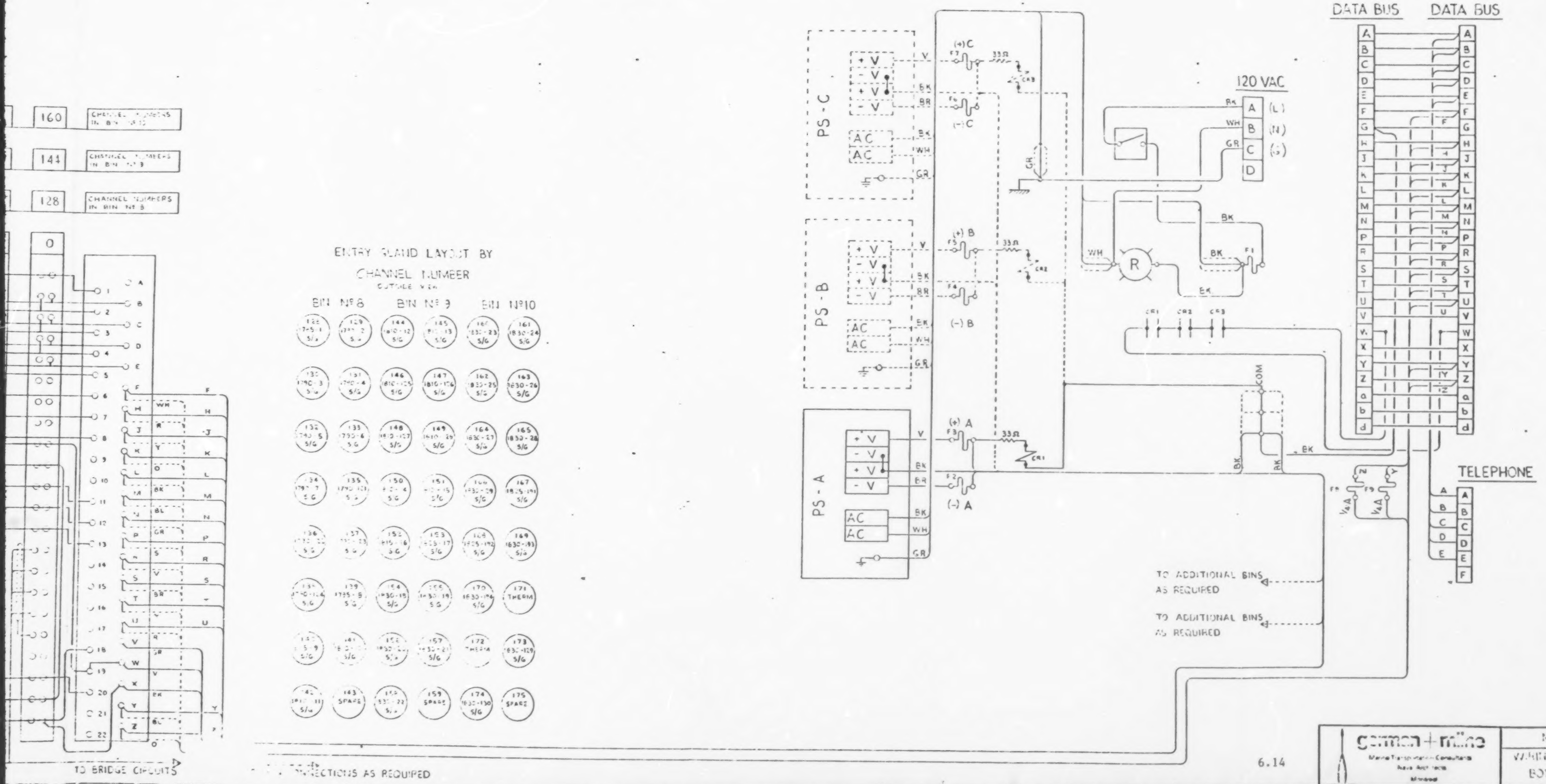
### CONNECTIONS FOR CHANNEL Nº 171 & 172


14
17
15
16
18
10 K
½ W
1%


175
174
173
172
171
170
169
168
167
166
165
164
163
162
161
160
CHANNEL NUMBERS IN BIN Nº 10
159
158
157
156
155
154
153
152
151
150
149
148
147
146
145
144
CHANNEL NUMBERS IN BIN Nº 9
143
142
141
140
139
138
137
136
135
134
133
132
131
130
129
128
CHANNEL NUMBERS IN BIN Nº 8
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
WH
R
Y
O
BK
BL
GR
S
V
BR
Y
R
GR
V
BK
BL
O
TO BRIDGE CIRCUITS
BIN
S/G

### BRIDGE CIRCUITS LAYOUT BY CHANNEL Nº




160
CHANNEL NUMBERS IN BIN No 10
144
CHANNEL NUMBERS IN BIN No 9
128
CHANNEL NUMBERS IN BIN No 8
0
TO BRIDGE CIRCUITS
CONNECTIONS AS REQUIRED
ENTRY GLAND LAYOUT BY CHANNEL NUMBER
OUTSIDE VIEW
BIN No 8
BIN No 9
BIN No 10
128
129
144
145
160
161
130
131
146
147
162
163
132
133
148
149
164
165
134
135
150
151
166
167
136
137
152
153
168
169
138
139
154
155
170
171
THERM
140
141
156
157
172
THERM
173
142
143
SPARE
158
159
SPARE
174
175
SPARE
S/G
PS - C
PS - B
PS - A
+ V
- V
AC
V
BK
BR
WH
GR
(+) C
(-) C
(+) B
(-) B
(+) A
(-) A
33Ω
CR1
CR2
CR3
120 VAC
A (L)
B (N)
C (G)
D
R
F1
COM
DATA BUS
DATA BUS
TELEPHONE
F8
F9
¼ A
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED

6.14

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M V

WIRING
BOX

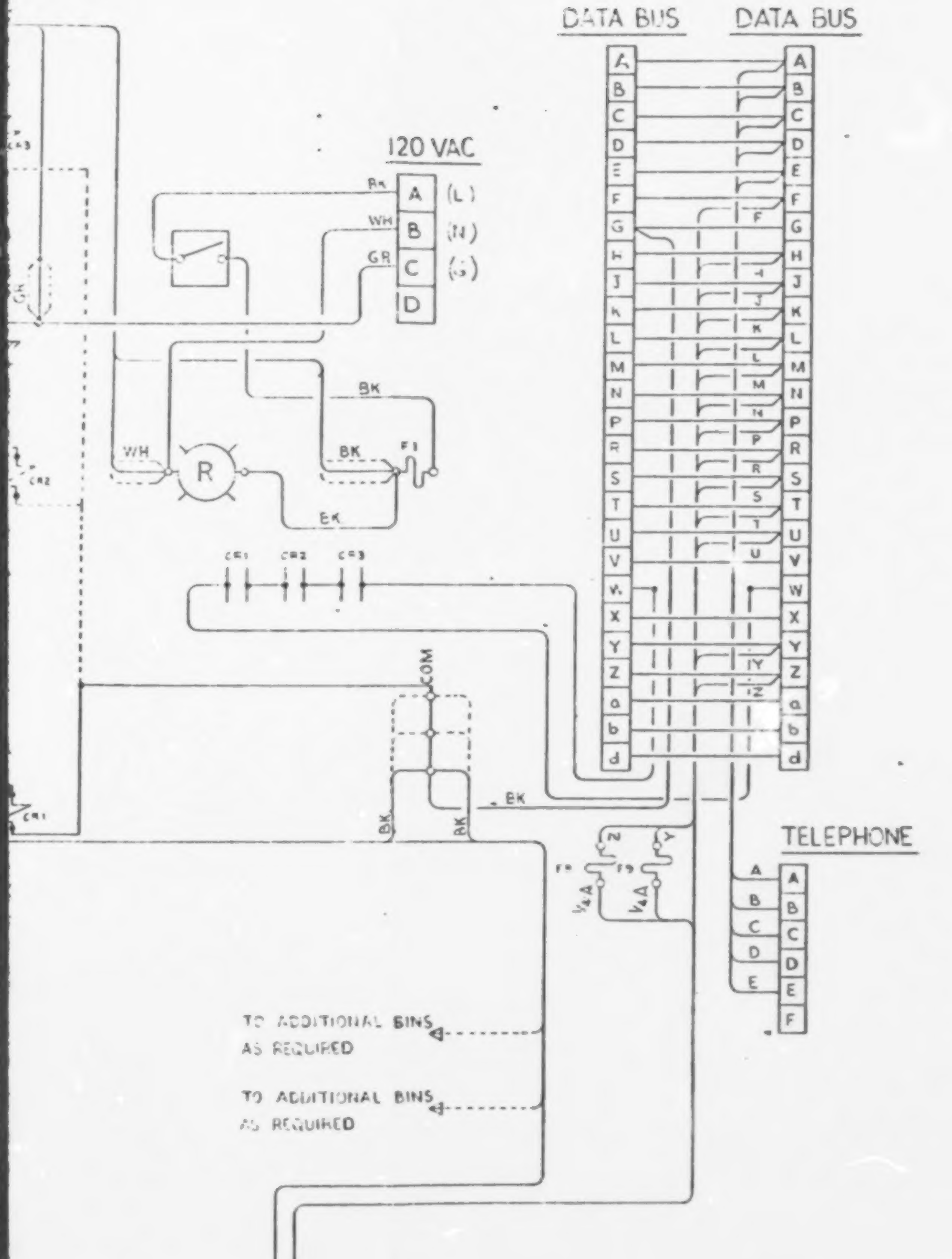
DATA BUS
DATA BUS
A B C D E F G H J K L M N P R S T U V W X Y Z a b d
A B C D E F G H J K L M N P R S T U V W X Y Z a b d
120 VAC
BK
WH
GR
A (L)
B (N)
C (G)
D
R
WH
BK
BK
BK
F1
CR1 CR2 CR3
COM
BK
BK
BK
F8
F9
¼A
¼A
TELEPHONE
A B C D E
A B C D E F
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED

FIG. 6.6

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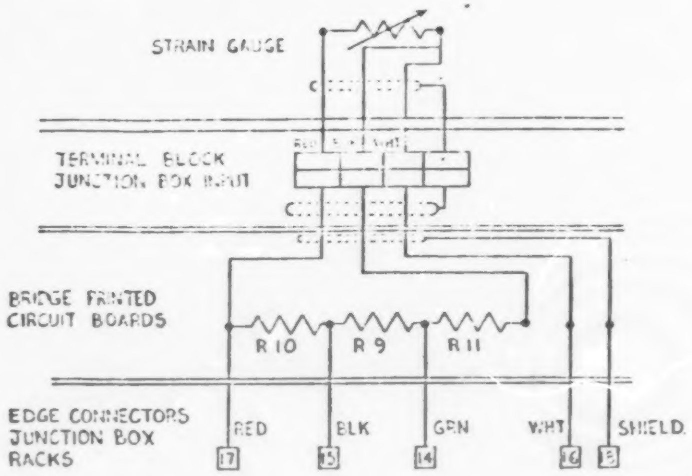
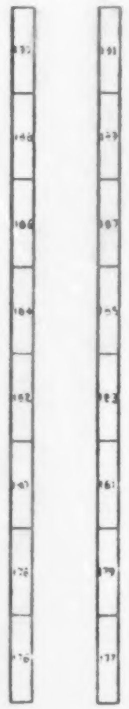
M V 'ARCTIC'
WIRING DIAGRAM
BOX Nº 4

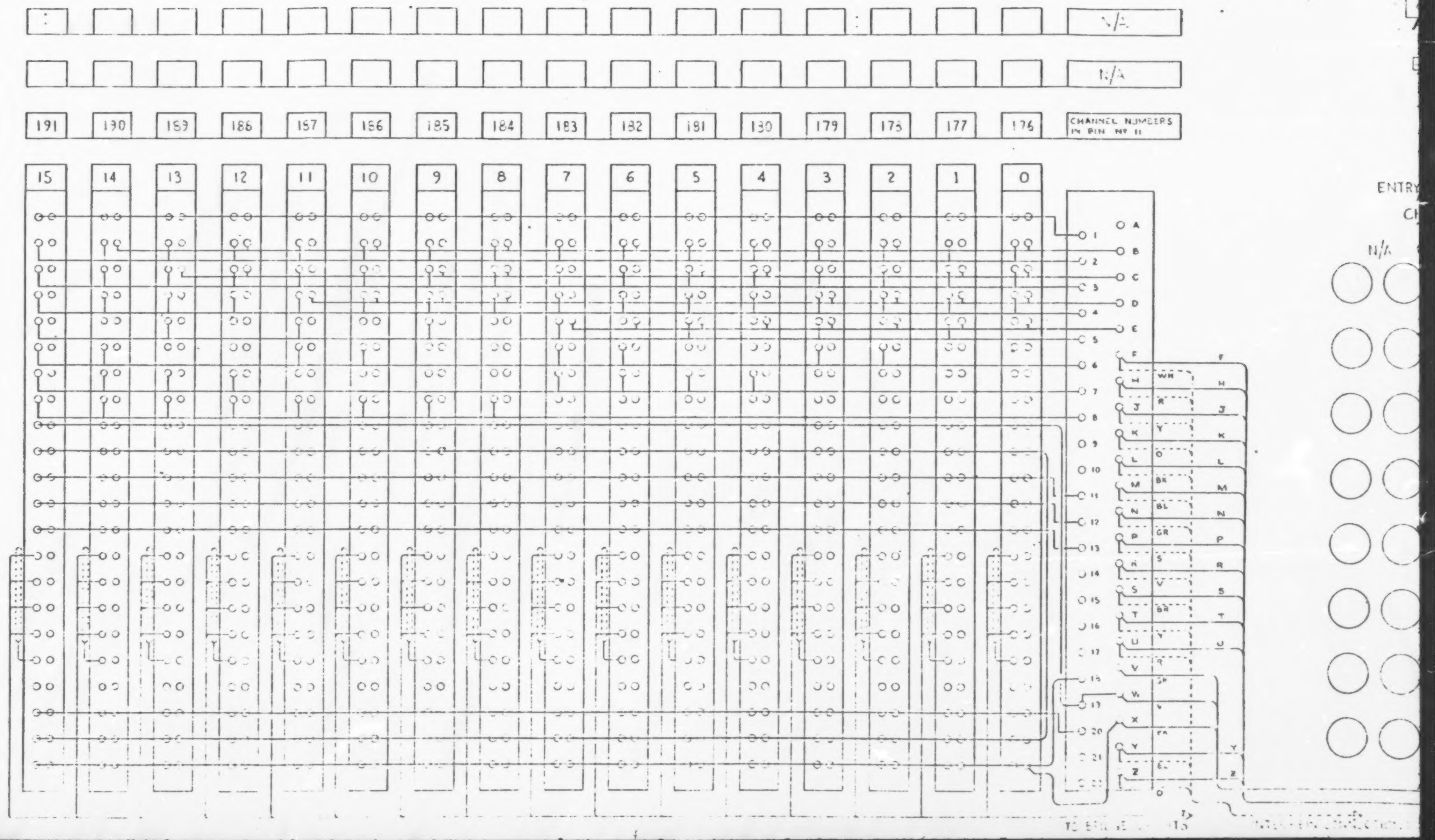
DATE : MARCH 197
DRAWN : W A R M
DWG Nº : 3501-204

TYPICAL
STRAIN GAUGE CONNECTIONS

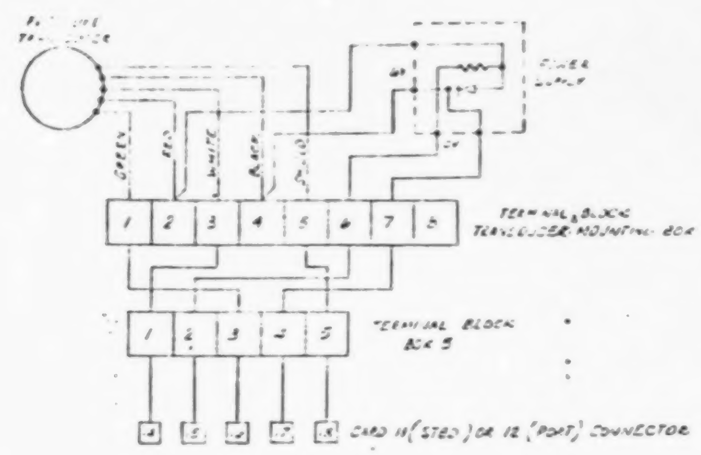

STRAIN GAUGE
TERMINAL BLOCK JUNCTION BOX INPUT
BRIDGE PRINTED CIRCUIT BOARDS
R 10
R 9
R 11
EDGE CONNECTORS JUNCTION BOX RACKS
RED
BLK
GRN
WHT
SHIELD.
17
15
14
16
13

BRIDGE CIRCUITS
LAYOUT BY CHANNEL Nº


190
188
186
184
182
180
178
176
191
189
187
185
183
181
179
177

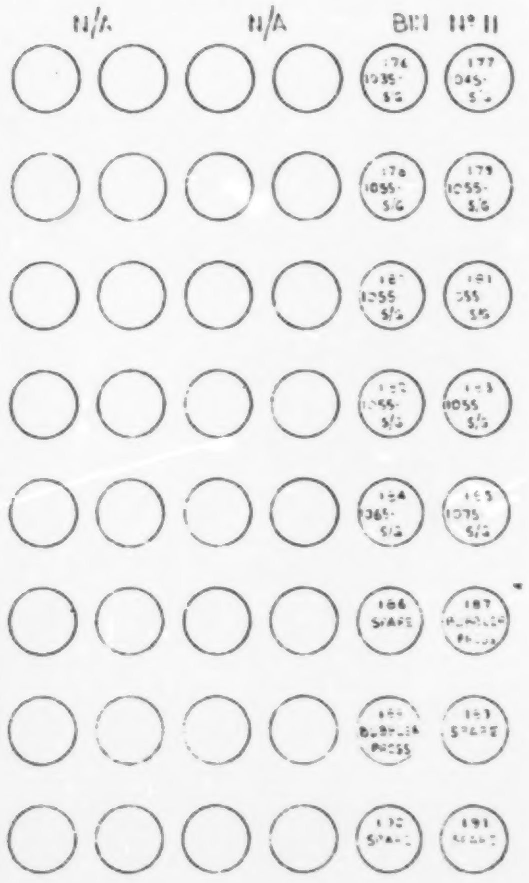

N/A
N/A
191
190
189
188
187
186
185
184
183
182
181
180
179
178
177
176
CHANNEL NUMBERS IN PIN Nº 11
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
A
1
B
2
C
3
D
4
E
5
F
6
H
7
J
8
K
9
L
10
M
11
N
12
P
13
R
14
S
15
T
16
U
17
V
18
W
19
X
20
Y
21
Z
22
WH
R
Y
O
BK
BL
GR
S
V
BR
Y
R
SP
V
PK
BL
O
ENTRY
CH
N/A
TO BRIDGE

CONNECTIONS FOR CHANNELS No 187 & 189


TRANSDUCER
GREEN
RED
WHITE
BLACK
POWER SUPPLY
1 2 3 4 5 6 7 8
TERMINAL BLOCK TRANSDUCER MOUNTING BOX
1 2 3 4 5
TERMINAL BLOCK BOX 5
CARD 11 (STBD) OR 12 (PORT) CONNECTOR

ENTRY GLAND LAYOUT BY CHANNEL NUMBER

OUTSIDE VIEW


N/A
N/A
BIN No II
176 1035-S/G
177 1045-S/G
178 1055-S/G
179 1055-S/G
181 1055 S/G
191 1055 S/G
184 1065-S/G
185 1075 S/G
186 SPARE
187 BUBBLER PRESS
189 BUBBLER PRESS
SPARE
SPARE
191 SPARE

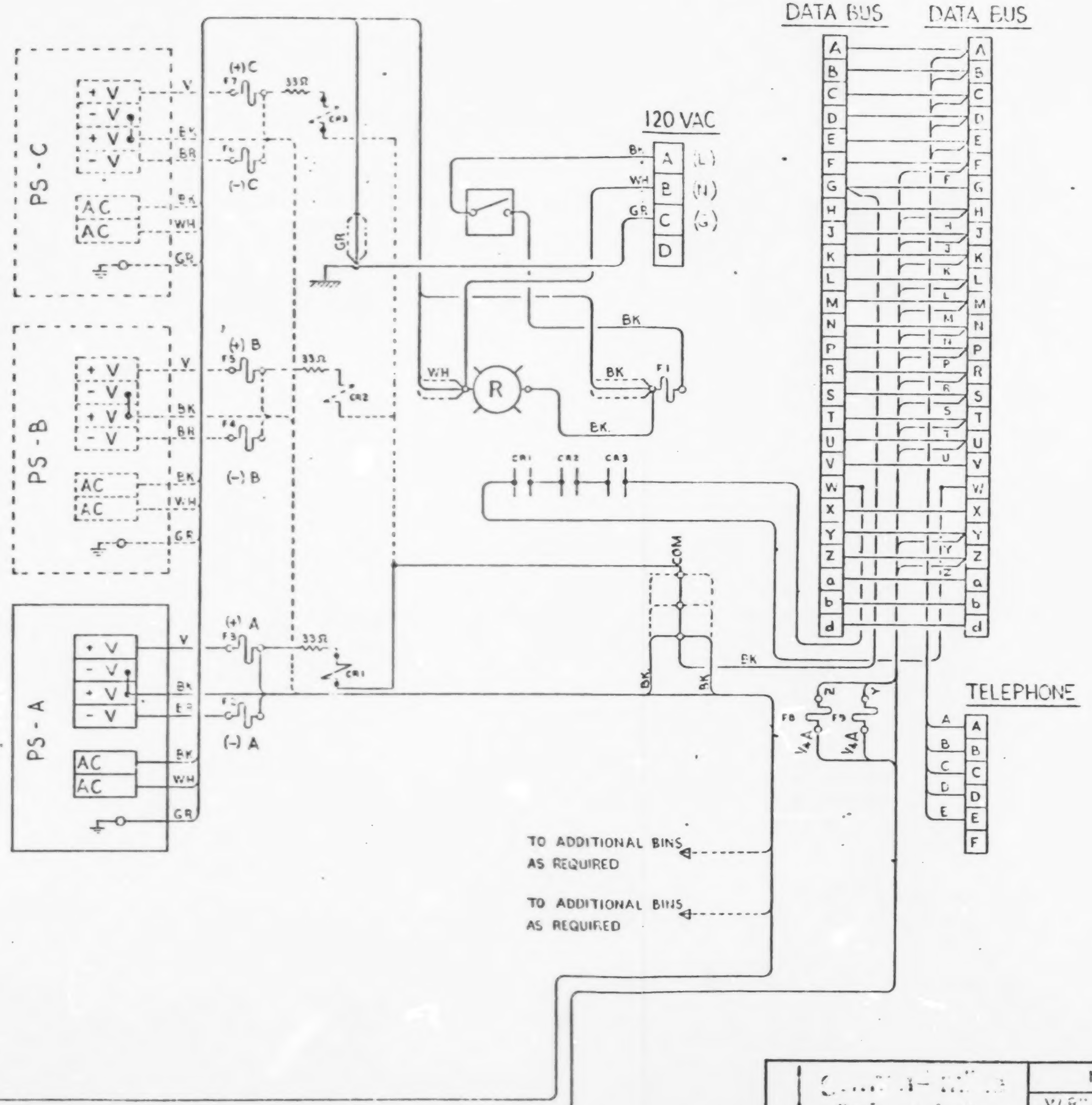
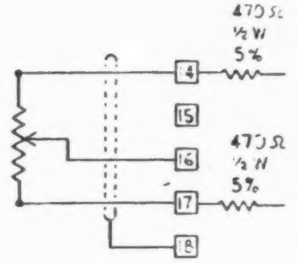

PS-C
PS-B
PS-A
+V
-V
+V
-V
AC
AC
V
BK
BR
WH
GR
(+) C
(-) C
(+) B
(-) B
(+) A
(-) A
F1
F3
F4
F5
F7
F8
F9
33Ω
CR1
CR2
CR3
120 VAC
A (L)
B (N)
C (G)
D
R
BK
WH
COM
¼A
¼A
DATA BUS
DATA BUS
A B C D E F G H J K L M N P R S T U V W X Y Z a b d
TELEPHONE
A B C D E F
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED

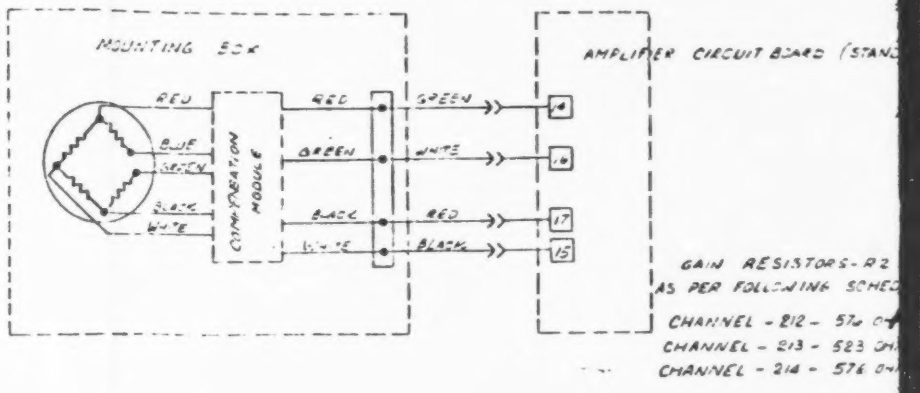
FIG. 6.7

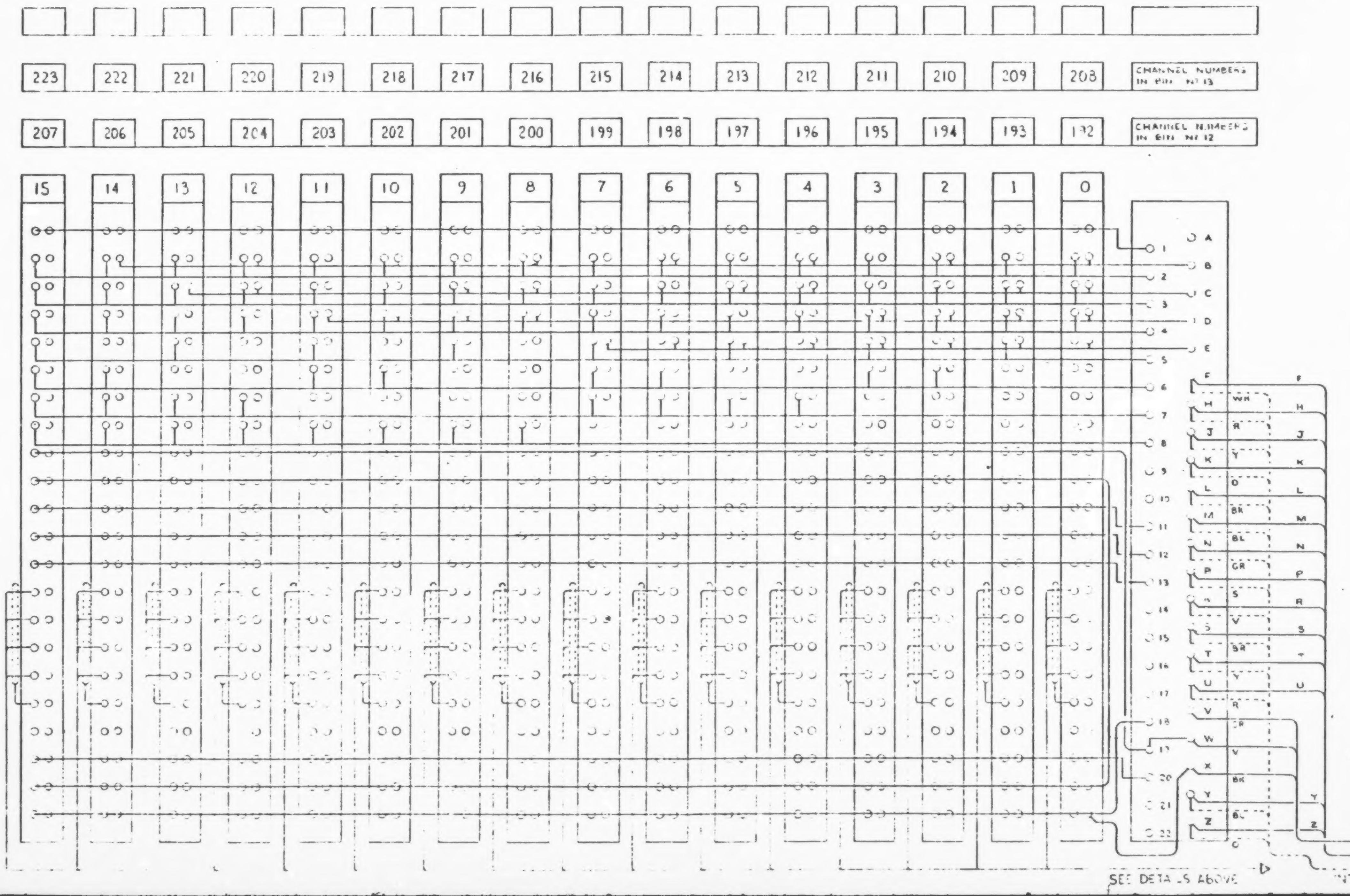
| | | |
|---|---|---|
| | M V 'ARCTIC' | DATE : MARCH 1' |
| | WIRING DIAGRAM<br>BOX No 5 | DRAWN : W A R M |
| | | DWG No : 3501-205 |

## CONNECTIONS FOR CHANNELS Nº 199, 200 & 201


470 Ω
½ W
5%
14
15
16
470 Ω
½ W
5%
17
18

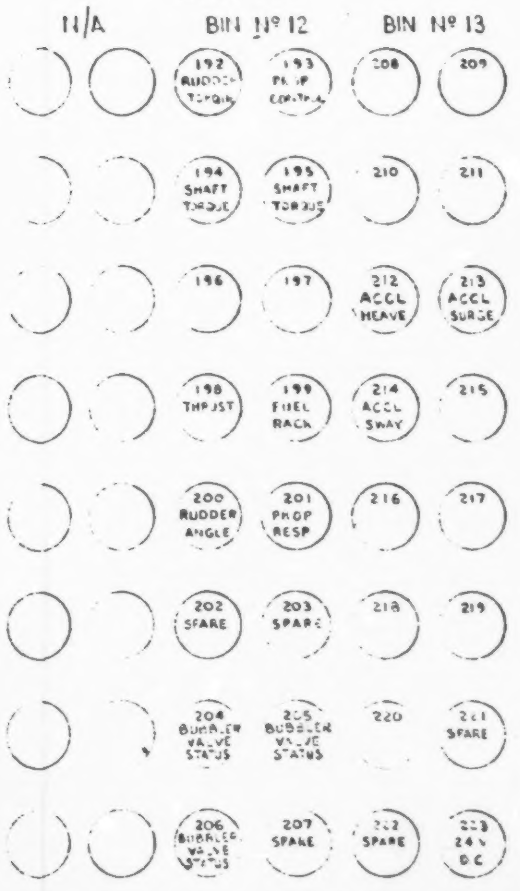
## CONNECTIONS FOR CHANNELS Nºs 212, 213 & 214


MOUNTING BOX
RED
BLUE
GREEN
BLACK
WHITE
COMPENSATION MODULE
RED
GREEN
BLACK
WHITE
GREEN
WHITE
RED
BLACK
14
16
17
15
AMPLIFIER CIRCUIT BOARD (STAN
GAIN RESISTORS - R2
AS PER FOLLOWING SCHED
CHANNEL - 212 - 576 OH
CHANNEL - 213 - 523 OH
CHANNEL - 214 - 576 OH

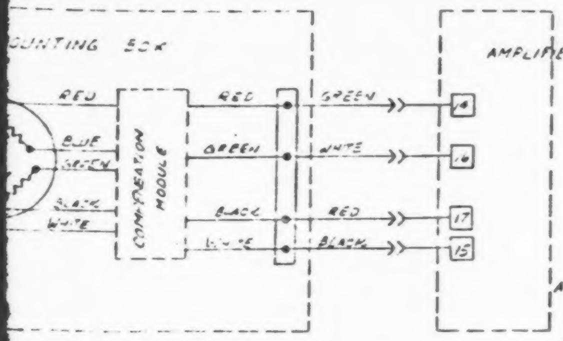

223 222 221 220 219 218 217 216 215 214 213 212 211 210 209 208
CHANNEL NUMBERS IN BIN Nº 13
207 206 205 204 203 202 201 200 199 198 197 196 195 194 193 192
CHANNEL NUMBERS IN BIN Nº 12
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
A B C D E F H J K L M N P R S T U V W X Y Z
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
WH
R
Y
O
BK
BL
GR
S
V
BR
SEE DETAILS ABOVE
INTER-BIN CONNECTION AS REQUIRED

## ENTRY CONNECTOR LAYOUT BY CHANNEL NUMBER

OUTSIDE VIEW

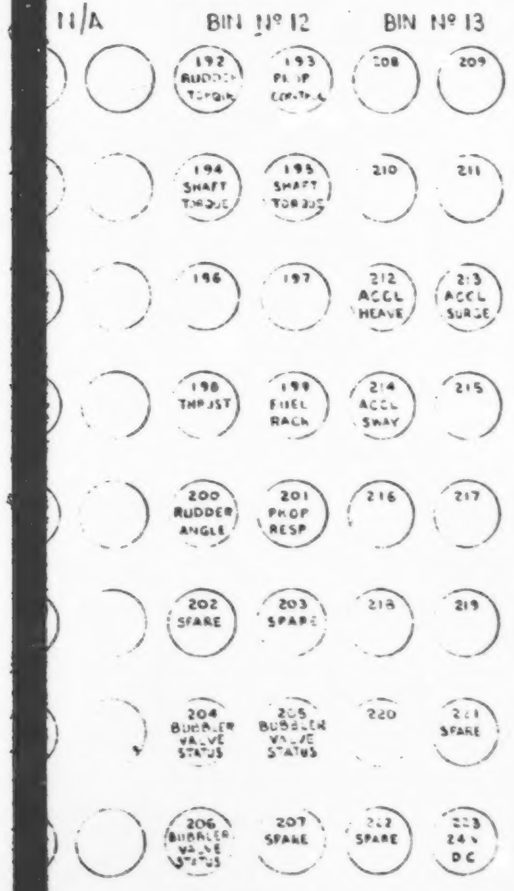

N/A
BIN Nº 12
BIN Nº 13
192 RUDDER TORQUE
193 PROP CONTROL
208
209
194 SHAFT TORQUE
195 SHAFT TORQUE
210
211
196
197
212 ACCL HEAVE
213 ACCL SURGE
198 THRUST
199 FUEL RACK
214 ACCL SWAY
215
200 RUDDER ANGLE
201 PROP RESP
216
217
202 SPARE
203 SPARE
218
219
204 BUBBLER VALVE STATUS
205 BUBBLER VALVE STATUS
220
221 SPARE
206 BUBBLER VALVE STATUS
207 SPARE
222 SPARE
223 24 V DC

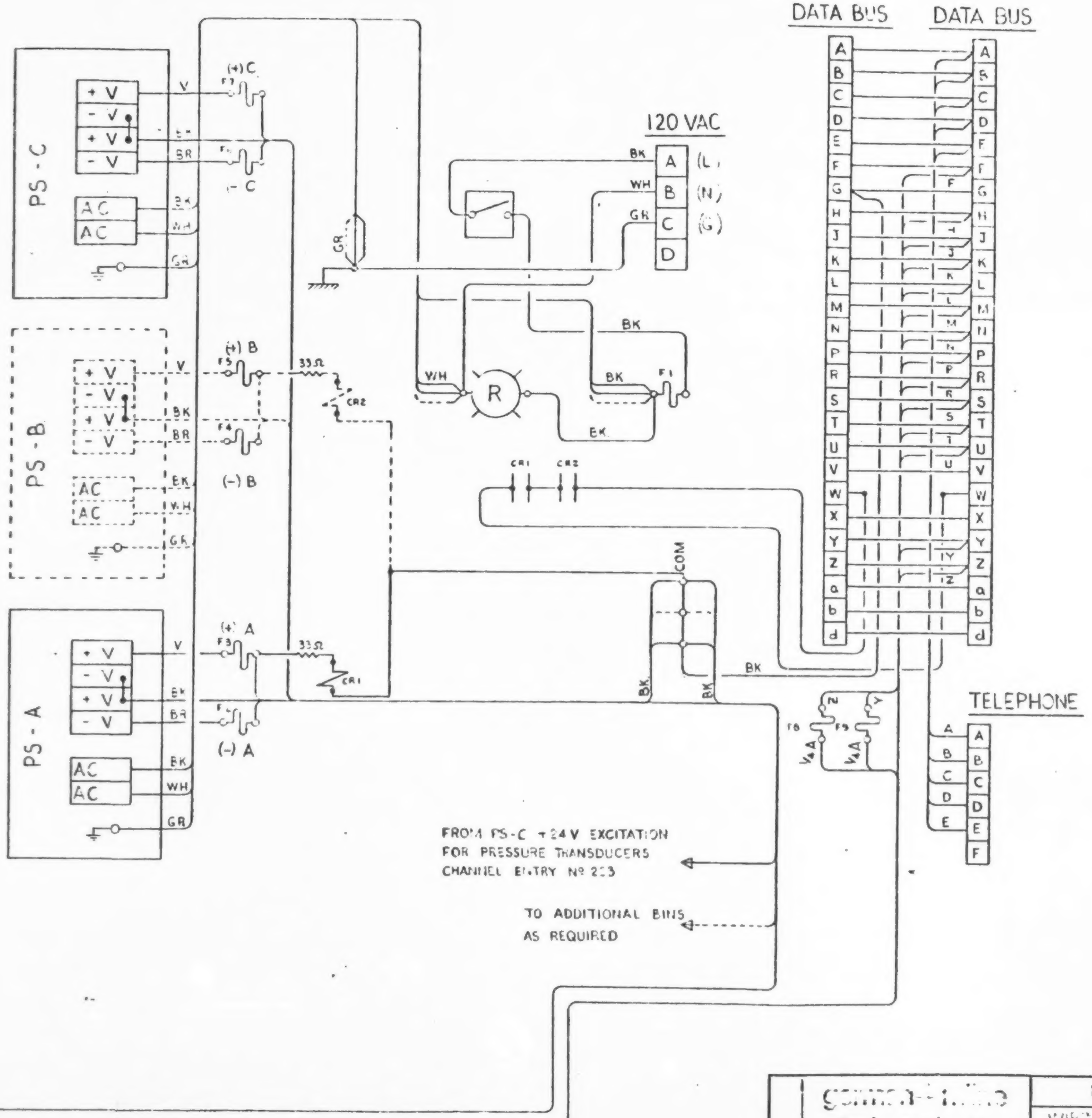
ONNECTIONS FOR CHANNELS Nos 212, 213 & 214


OUNTING BOX
AMPLIFIER CIRCUIT BOARD (STANDARD)
RED
BLUE
GREEN
BLACK
WHITE
COMPENSATION MODULE
RED
GREEN
BLACK
WHITE
GREEN
WHITE
RED
BLACK
14
16
17
15

GAIN RESISTORS - R2
AS PER FOLLOWING SCHEDULE
CHANNEL - 212 - 576 OHMS
CHANNEL - 213 - 523 OHMS
CHANNEL - 214 - 576 OHMS

ENTRY CONNECTOR LAYOUT BY CHANNEL NUMBER
OUTSIDE VIEW


N/A
BIN No 12
BIN No 13
192 RUDDER TORQUE
193 PROP CONTROL
208
209
194 SHAFT TORQUE
195 SHAFT TORQUE
210
211
196
197
212 ACCL HEAVE
213 ACCL SURGE
198 THRUST
199 FUEL RACK
214 ACCL SWAY
215
200 RUDDER ANGLE
201 PROP RESP
216
217
202 SPARE
203 SPARE
218
219
204 BUBBLER VALVE STATUS
205 BUBBLER VALVE STATUS
220
221 SPARE
206 BUBBLER VALVE STATUS
207 SPARE
222 SPARE
223 24V DC


PS - C
PS - B
PS - A
+ V
- V
+ V
- V
AC
AC
V
BK
BR
WH
GR
(+) C
(-) C
(+) B
(-) B
(+) A
(-) A
F1
F2
F3
F4
F5
F8
F9
33Ω
33Ω
CR1
CR2
120 VAC
A
B
C
D
(L)
(N)
(G)
R
COM
DATA BUS
DATA BUS
TELEPHONE
V4A
V4A

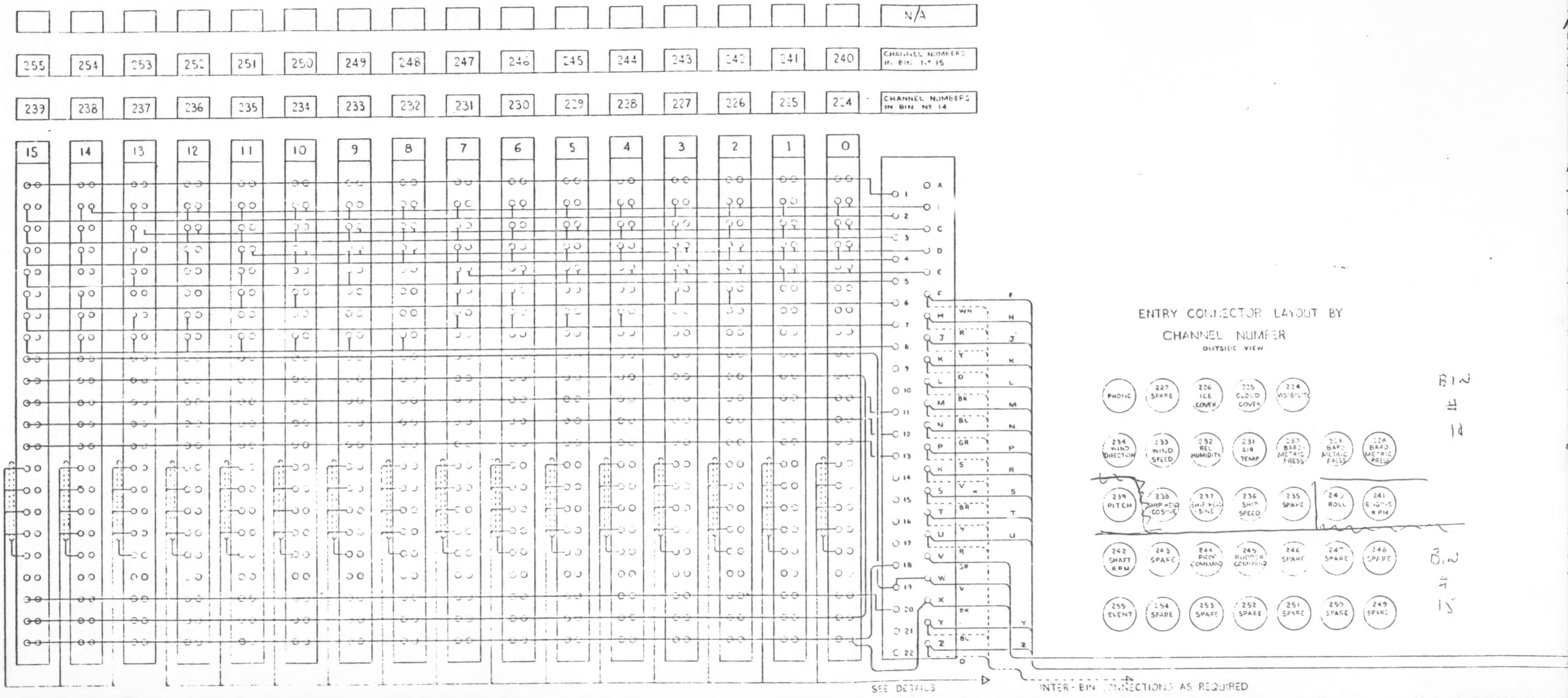
FROM PS-C +24V EXCITATION
FOR PRESSURE TRANSDUCERS
CHANNEL ENTRY No 223

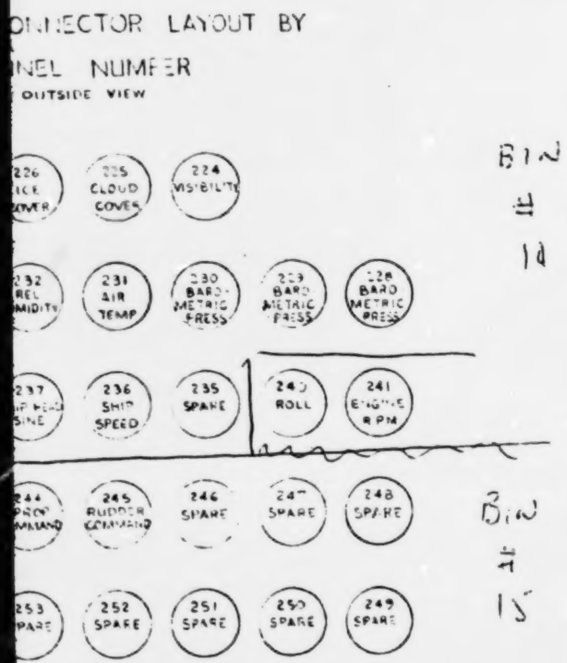
TO ADDITIONAL BINS
AS REQUIRED

AS REQUIRED

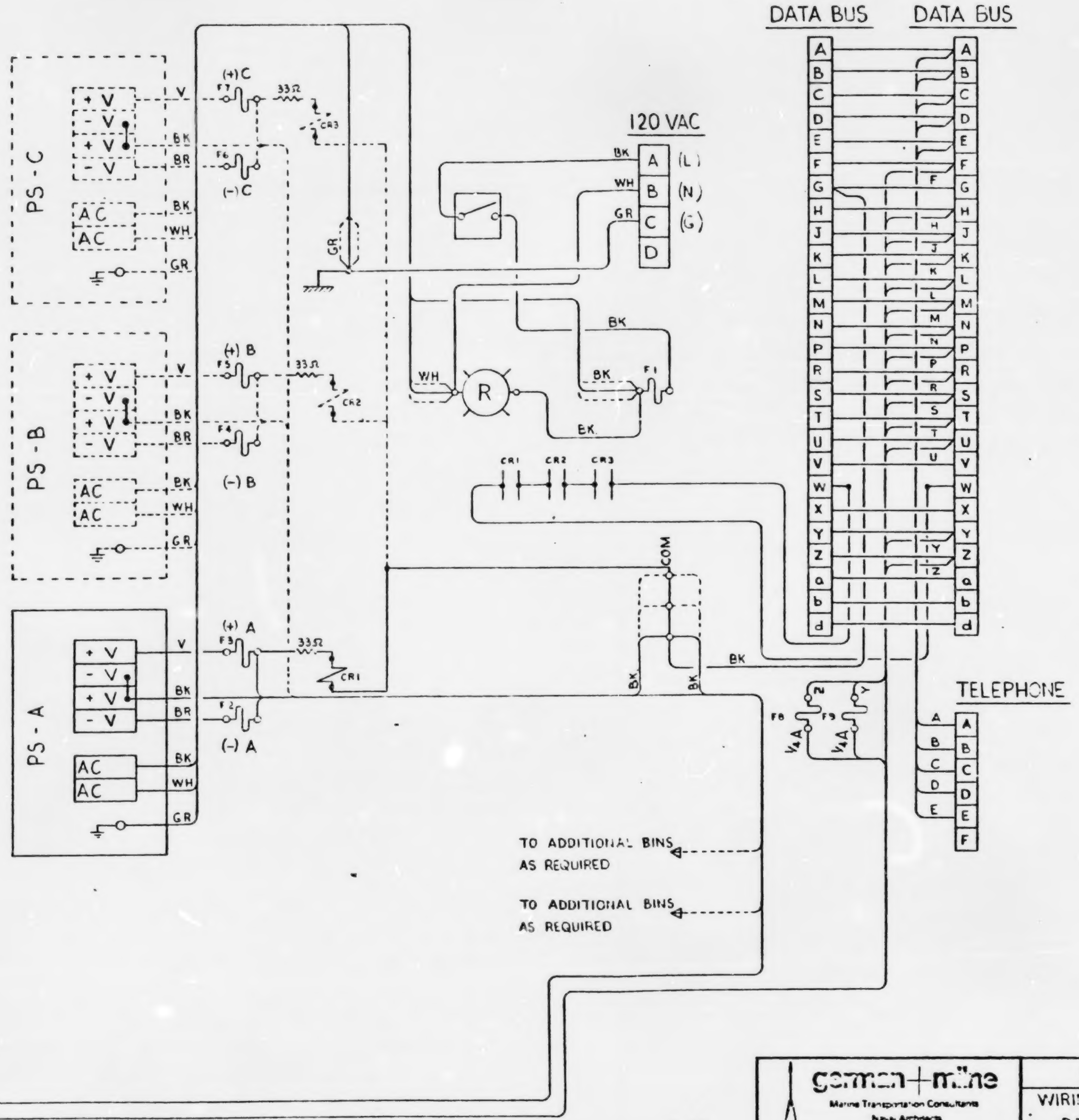
FIG. 6.8

| | | |
|---|---|---|
| 6.16 | M V 'ARCTIC' | DATE : MARCH 1° |
| | WIRING DIAGRAM BOX No 6 | DRAWN : W A K M |
| | | DWG No 3501-2… |


N/A
CHANNEL NUMBERS IN BIN № 15
255
254
253
252
251
250
249
248
247
246
245
244
243
242
241
240
CHANNEL NUMBERS IN BIN № 14
239
238
237
236
235
234
233
232
231
230
229
228
227
226
225
224
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
WH
R
Y
O
BR
BL
GR
S
V
BR
Y
R
GR
V
BK
BL
O
SEE DETAILS
INTER-BIN CONNECTIONS AS REQUIRED
ENTRY CONNECTOR LAYOUT BY CHANNEL NUMBER
OUTSIDE VIEW
PHONE
227 SPARE
226 ICE COVER
225 CLOUD COVER
224 VISIBILITY
234 WIND DIRECTION
233 WIND SPEED
232 REL HUMIDITY
231 AIR TEMP
230 BARO-METRIC PRESS
229 BARO METRIC PRESS
228 BARO METRIC PRESS
239 PITCH
238 SHIP HEAD COSINE
237 SHIP HEAD SINE
236 SHIP SPEED
235 SPARE
240 ROLL
241 ENGINE RPM
242 SHAFT RPM
243 SPARE
244 PROP COMMAND
245 RUDDER COMMAND
246 SPARE
247 SPARE
248 SPARE
255 EVENT
254 SPARE
253 SPARE
252 SPARE
251 SPARE
250 SPARE
249 SPARE
BIN # 14
BIN # 15



ONNECTOR LAYOUT BY
NEL NUMFER
OUTSIDE VIEW
226 ICE COVER
225 CLOUD COVES
224 VISIBILITY
232 REL MIDITY
231 AIR TEMP
230 BARO-METRIC PRESS
229 BARO METRIC PRESS
228 BARO METRIC PRESS
237
236 SHIP SPEED
235 SPARE
240 ROLL
241 ENGINE RPM
244 PROP MMAND
245 RUDDER COMMAND
246 SPARE
247 SPARE
248 SPARE
253 SPARE
252 SPARE
251 SPARE
250 SPARE
249 SPARE
BIN # 14
BIN # 15



PS - C
PS - B
PS - A
+ V
- V
AC
V
BK
BR
WH
GR
(+) C
(-) C
(+) B
(-) B
(+) A
(-) A
F1
F2
F3
F4
F5
F6
F7
F8
F9
33Ω
CR1
CR2
CR3
120 VAC
A (L)
B (N)
C (G)
D
R
DATA BUS
DATA BUS
COM
TELEPHONE
V4A
TO ADDITIONAL BINS AS REQUIRED
TO ADDITIONAL BINS AS REQUIRED

RQUIRED

FIG. 6.9

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M V 'ARCTIC'

WIRING DIAGRAM
BOX Nº 7

DATE : MARCH 19
DRAWN : W.A.R.M
DWG Nº . 3501- 2

# SECTION 7

# INTERFACE

## Section 7: Interface

7.1 General

7.2 Utility Module

7.3 Analogue to Digital Converter Module

7.4 Logic Module

7.5 Driver Modules

7.6 Alarm and Monitoring Module

7.7 Sound Module

7.8 Power Module

7.9 Description of Old Interface

## 7.1 General

The Main Interface provides necessary coupling, level shifting, analog to digital conversion, and some monitoring between the computer and remote interface cabinets.

The Main Interface is contained in a separate section of the computer rack and powered from dedicated ±15VDC and +5VDC power supplies. The following modules make up the rack:

- Utility Module, providing telephone connection over the analogue bus and a provision for the analog data monitoring.
- Analog to digital converter module converting analog data to 10 bit offset binary format.
- Logic module providing necessary sequencing and monitoring of computer signals.
- Driver modules #1 and #2 are buffering computer and logic module signals, providing as well the level shifting from 5V to 15V to obtain better noise immunity.
- Alarm and monitoring module, providing alarm circuits for alarms A, B, and C and initialization of "Enable", "Real/Peak" and "Clear" signals.
- Sound module provides audible alarm in the case of any alarm condition.
- Power module indicates presence of the +5V power supply and provides fuses and ON/OFF switch for 110VAC line.

All connections but those for monitoring and telephone are on the rear of the rack. Two connectors are provided for the analogue bus connections, one terminal strip for the power supply connections (fig. 7.1).

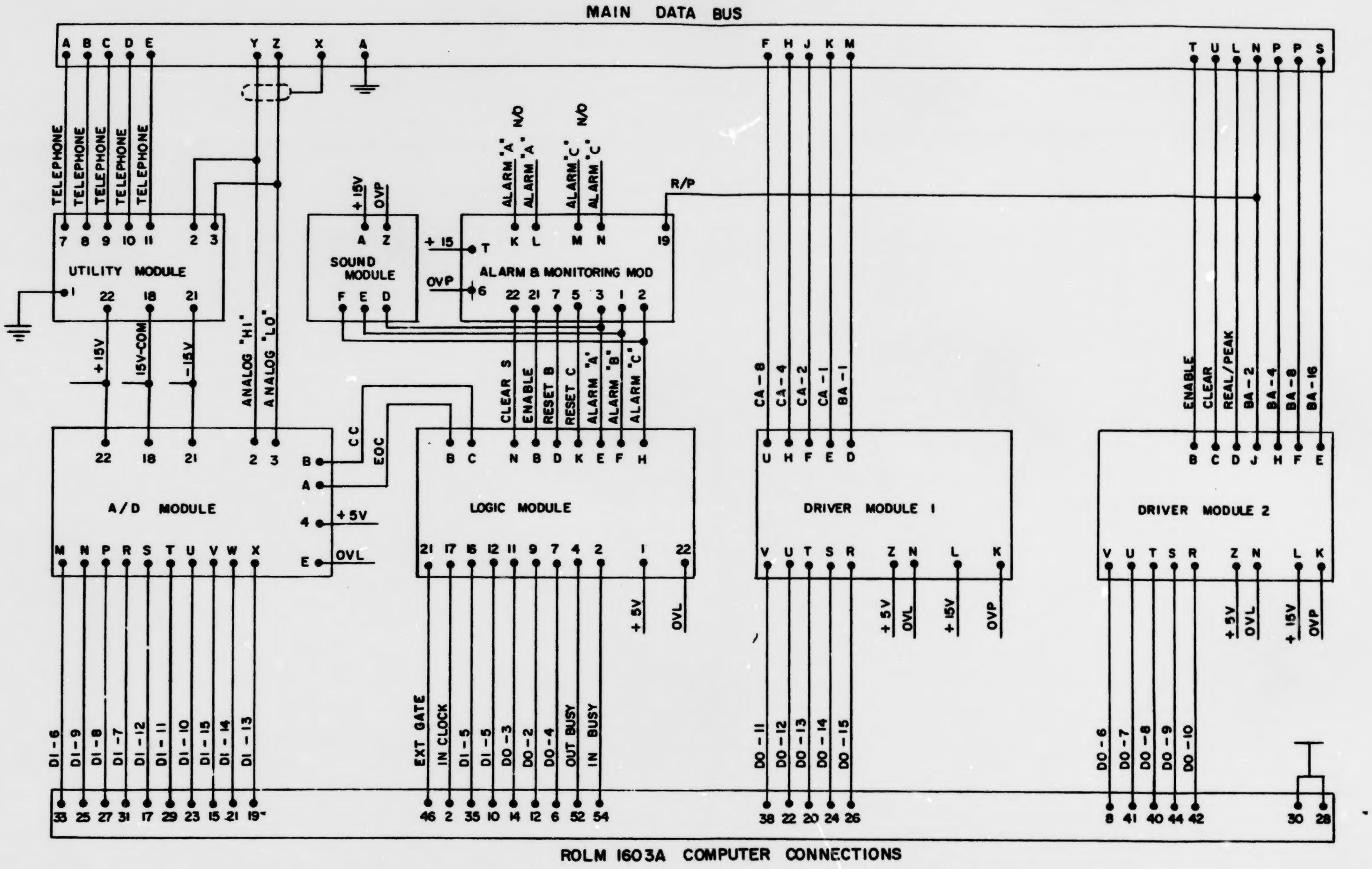

MAIN DATA BUS
A B C D E Y Z X A
F H J K M
T U L N P P S
TELEPHONE
TELEPHONE
TELEPHONE
TELEPHONE
TELEPHONE
7 8 9 10 11 2 3
UTILITY MODULE
1 22 18 21
+15V
15V-COM
-15V
ANALOG "HI"
ANALOG "LO"
+15V
OVP
A Z
SOUND MODULE
F E D
ALARM "A" N/O
ALARM "A"
ALARM "C" N/O
ALARM "C"
R/P
+15
T
OVP
6
K L M N 19
ALARM & MONITORING MOD
22 21 7 5 3 1 2
CLEAR S
ENABLE
RESET B
RESET C
ALARM "A"
ALARM "B"
ALARM "C"
CC
EOC
22 18 21 2 3
B
A
4 +5V
E OVL
A/D MODULE
M N P R S T U V W X
B C N B D K E F H
LOGIC MODULE
21 17 16 12 11 9 7 4 2 1 22
+5V
OVL
CA-8
CA-4
CA-2
CA-1
BA-1
U H F E D
DRIVER MODULE 1
V U T S R Z N L K
+5V
OVL
+15V
OVP
ENABLE
CLEAR
REAL/PEAK
BA-2
BA-4
BA-8
BA-16
B C D J H F E
DRIVER MODULE 2
V U T S R Z N L K
+5V
OVL
+15V
OVP
DI-6
DI-9
DI-8
DI-7
DI-12
DI-11
DI-10
DI-15
DI-14
DI-13
EXT GATE
IN CLOCK
DI-5
DI-5
DO-3
DO-2
DO-4
OUT BUSY
IN BUSY
DO-11
DO-12
DO-13
DO-14
DO-15
DO-6
DO-7
DO-8
DO-9
DO-10
33 25 27 31 17 29 23 15 21 19
46 2 35 10 14 12 6 52 54
38 22 20 24 26
8 41 40 44 42
30 28
ROLM 1603A COMPUTER CONNECTIONS

FIG. 7.1
WIRING DIAGRAM, MAIN INTERFACE

## 7.2 Utility Module

The utility module provides connection for a pair of battery powered telephones, via the analogue bus, to any of the remote interface cabinets, and a buffered analogue bus output for monitoring purposes (fig. 7.2).

This buffering utilizes the same instrumentation amplifier, AD 521, and in the same configuration as in the A/D converter module.

### Adjustments

- Disconnect the analogue bus and connect extender cable instead.
- Short out analogue bus (PINS Y and Z) to ground (PIN X) and adjust offset to obtain an output of 0.00V.
- Connect +10V (referred to ground) to both inputs (PINS Y and X) and adjust balance to obtain 0.00V at the output.
- Connect 10.00 Volts between inputs and adjust gain to obtain 10.00V at the output.

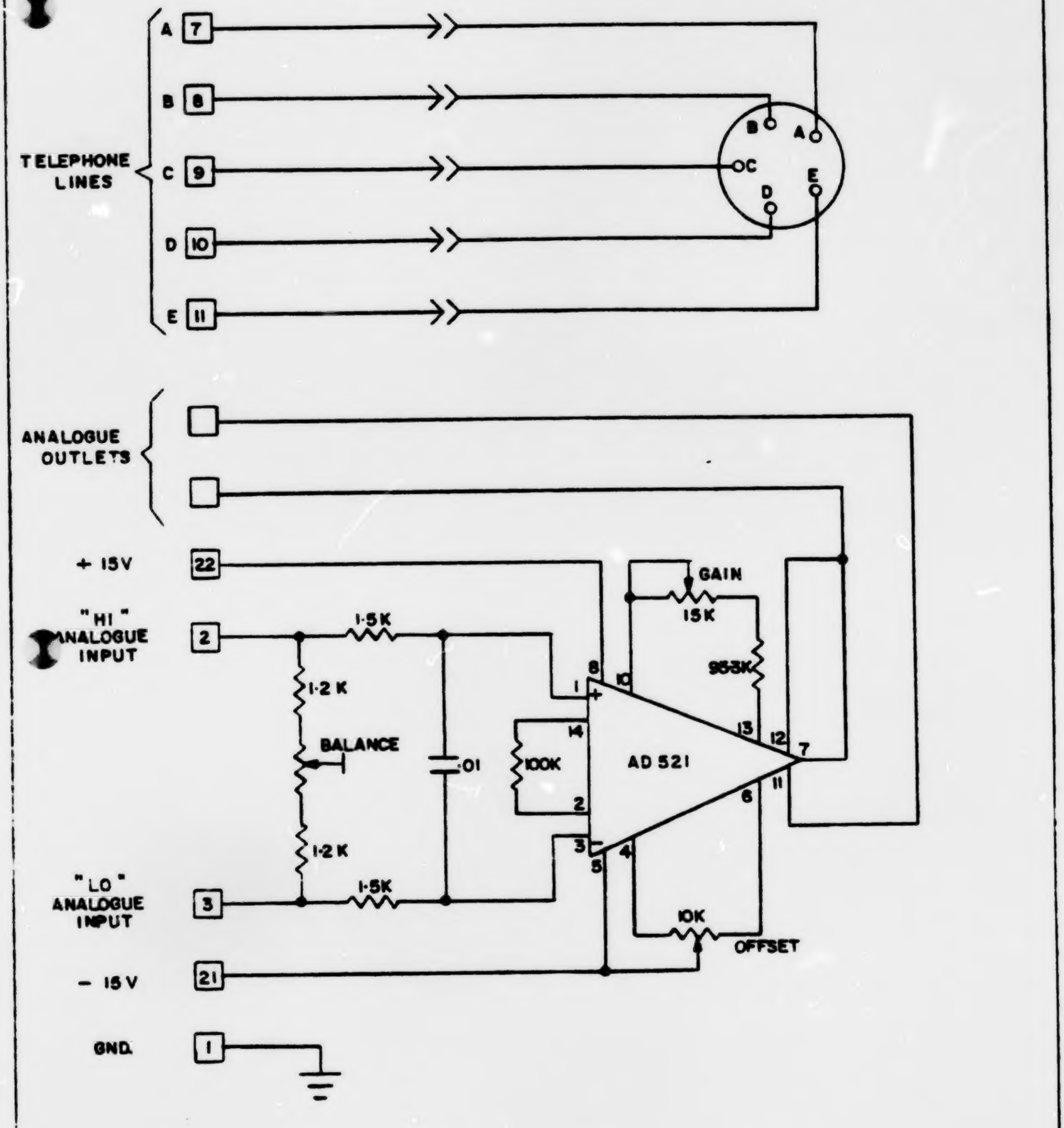

TELEPHONE LINES
A
7
B
8
C
9
D
10
E
11
B
A
C
E
D
ANALOGUE OUTLETS
+ 15V
22
GAIN
15K
"HI" ANALOGUE INPUT
2
1·5K
953K
1·2 K
8
10
1
14
13
12
7
BALANCE
.01
100K
AD 521
11
6
2
1·2 K
3
5
4
"LO" ANALOGUE INPUT
3
1·5K
10K
OFFSET
− 15 V
21
GND.
1

FIG. 7.2
LOGIC DIAGRAM, UTILITY MODULE (MAIN INTERFACE)

## 7.3 Analogue to Digital Converter Module

The A/D converter module converts analog data coming from the analogue bus to a 10 bit offset binary format (fig. 7.3).

The instrumentation amplifier AD 521 JD with gain adjusted to one serves as a buffer between the A/D converter and the differential voltage on the analogue bus. This provides signals with ground reference for the A/D input. A 30 micro second time constant, low pass filter at the input reduces any high frequency noise.

The A/D converter outputs are buffered with 7406 open collector buffers.

### Adjustments

Follow same adjustment procedure as per paragraph 2 for the utility module, but using the computer printout to monitor the module output. (+9.96V should be used instead of 10.00V at the input).

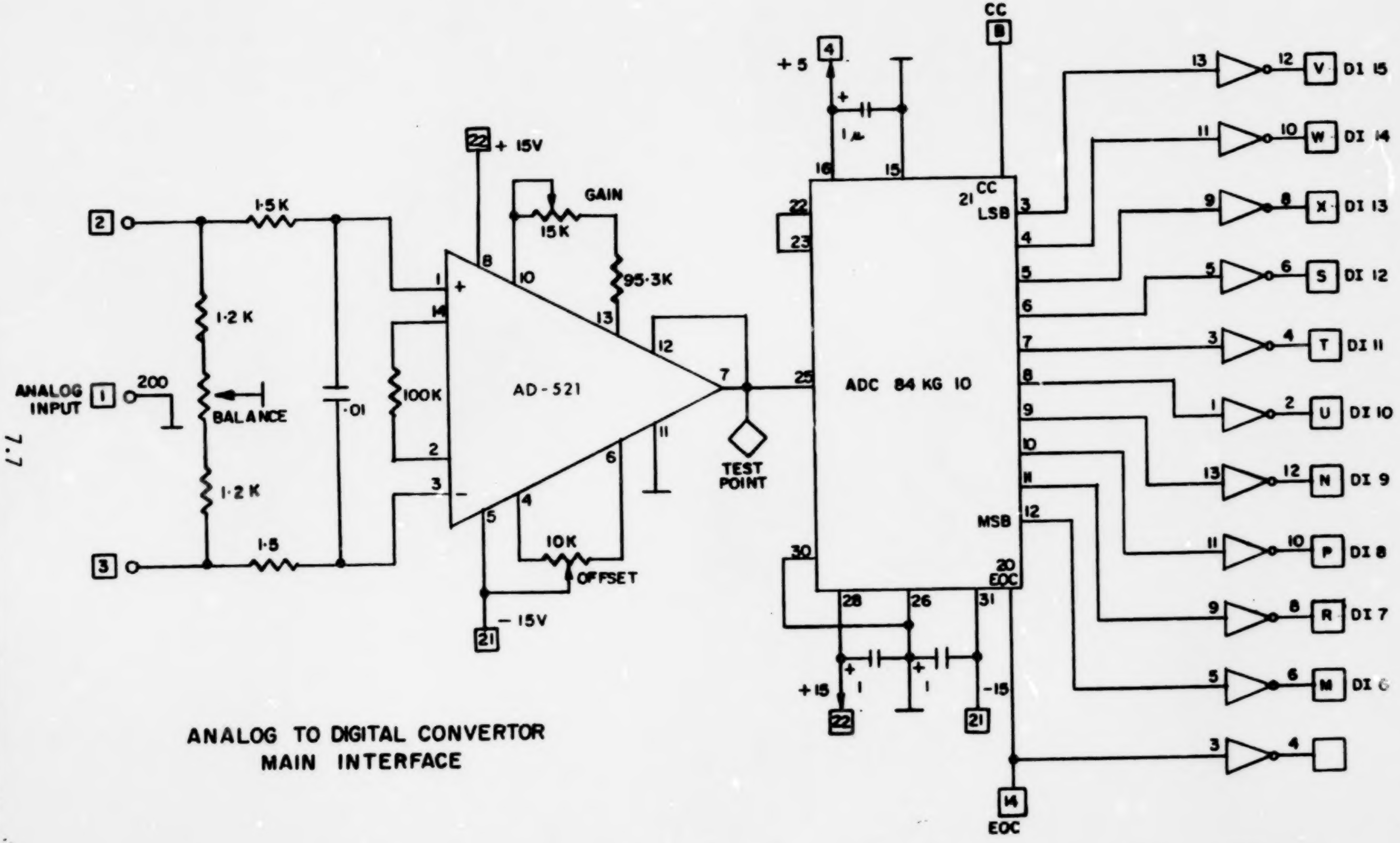

ANALOG INPUT
1
2
3
200
1·5K
1·2 K
BALANCE
1·2 K
1·5
·01
100K
22
+ 15V
GAIN
15K
95·3K
AD-521
10K
OFFSET
21
− 15V
TEST POINT
+ 5
4
1µ
CC
B
ADC 84 KG 10
CC
LSB
MSB
EOC
+15
22
−15
21
14
EOC
V
DI 15
W
DI 14
X
DI 13
S
DI 12
T
DI 11
U
DI 10
N
DI 9
P
DI 8
R
DI 7
M
DI 6
ANALOG TO DIGITAL CONVERTOR
MAIN INTERFACE

FIG. 7.3 LOGIC DIAGRAM, ANALOG TO DIGITAL CONVERTOR (MAIN INTERFACE)

3501 - 302

8/1979

## 7.4 Logic Module

The logic module provides all necessary sequencing between the computer, A/D converter, alarm module and the remote interface cabinets. Signals OUT BUSY and IN BUSY (active low) coming from the computer, are indicating output and input sequences. The logic module responds in turn with signals EXT GATE which defines the time necessary to accomplish a chosen 1/0 operation and IN CLOCK which clocks the A/D output and DIS status into computer input interface (fig. 7.4).

The OUT BUSY signal (DWG - No. 3501-303) sets flip flop U8B via U3C and produces EXT GATE signal (low) buffered with U3E and U2C. Outputs D02, D03, D04 and D05 are setting ALARM C, ALARM B, ALARM A and CLR signal respectively. Either D02, D03, or D04 are starting a 2 micro second time delay via or gate U11B.

Gates U14C and U14D with resistor R3 and capacitor C2 are delaying OUT BUSY signal for 1 micro second which in turn clocks D02 and/or D03 into flip flops U12B and U12A respectively.

The same signal enables gate U9C, slowing the reset of U8B flip flop via U4C and U11A. One shot circuit U44, D3, R5, C3, U15B and U4D ending this output operation.

It should be noted that the alarm A is clocked by the output of U3E via U15A triggering U13A, a 100 Milli seconds monostable, allowing for visualization of that signal.

A delay of 10 milli seconds, and therefore, same duration of CLR signal, serving for autozeroing of remote interface cabinets is provided by U15C, R14, R15, D4, C6 and U9A.

The same circuit resets U8B flip flop via U11A gate, ending this output operation.

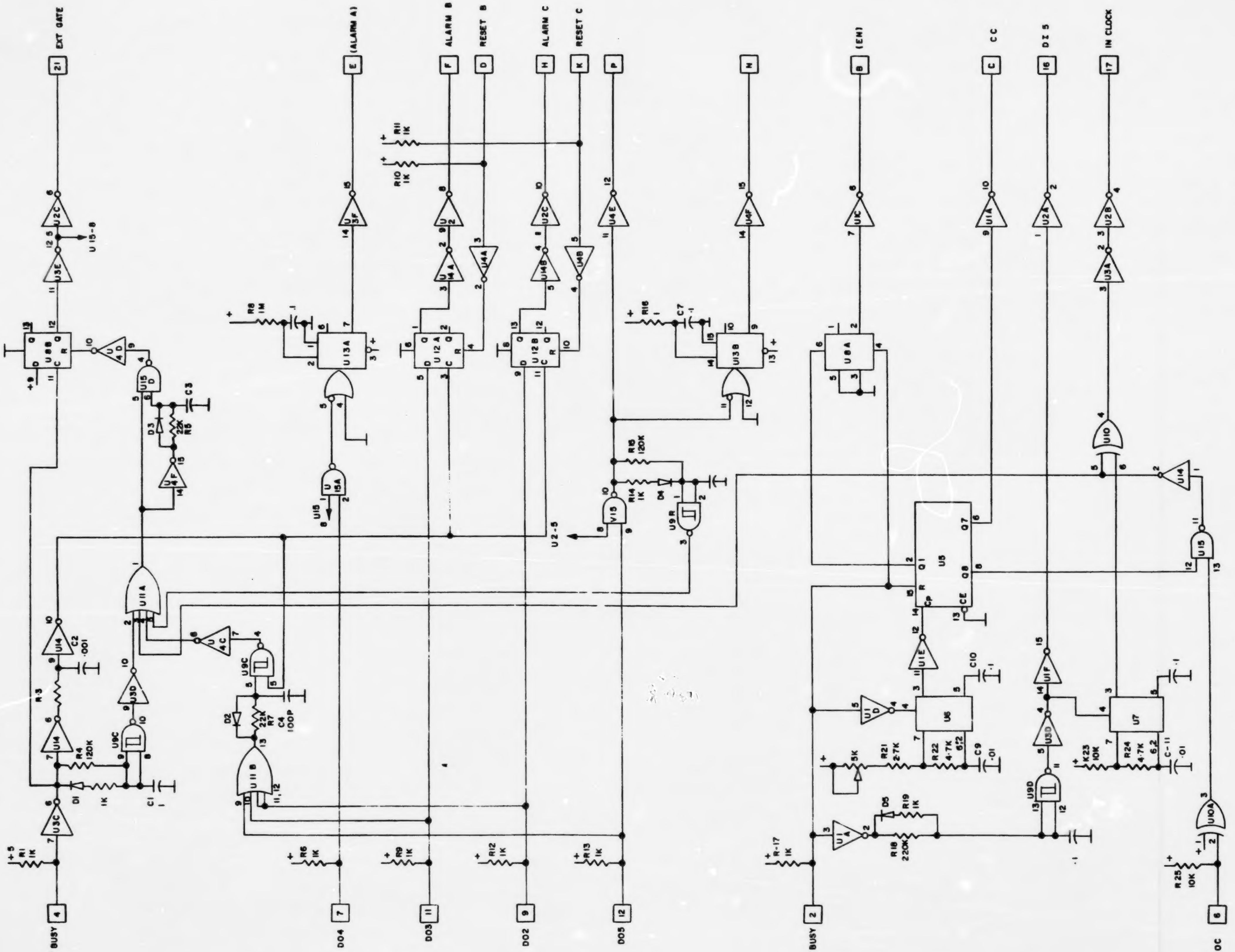

EXT GATE
(ALARM A)
ALARM B
RESET B
ALARM C
RESET C
(EN)
CC
DI 5
IN CLOCK
OUT BUSY
DO4
DO3
DO2
DO5
IN BUSY
EOC
U 15-8
U2-5
U5
U6
U7
U11A
U11B
U12A
U12B
U13A
U13B
U8A
U8B

FIG. 7.4

LOGIC DIAGRAM , LOGIC MODULE
(MAIN INTERFACE)

G. & M. DRAWING Nº 3501 - 303

8/1979

The monostable U13B with a pulse duration of 100 m.sec. allows for visualization of the CLR signal.

In the case of malfunctioning of some of the reset circuits, an additional reset for EXT GATE signal by the time delay circuit R2, R4, D1, C1, U9C and U3D with 10 milli sec. time constant acting via U11A, or gate prevents an indefinite halting of the computer by an I/O operation.

The input operation sequence, actually data gathering via analogue bus, starts with simultaneous setting of OUT BUSY, IN BUSY signals with appropriate remote interface address by the computer. Similar to the output sequences, the EXT GATE Signal goes low and remains low until the input operation is accomplished.

The IN BUSY signal, active low, removes reset from the JOHNSON counter U5 and flip flop U8A. This starts the sequencing oscilator U6 via buffer invertor U1 and 20b milli sec. delay circuit U1A, R18, R19, D5, C8, U9D serving as a back-up circuit to produce D15 signal, indicating A/D converter and/or sequencer malfunctioning. IN CLOCK, by enabling the oscilator U7, releases the computer from the input routine.

The oscilator U6 should be adjusted to period of 30 micro seconds by the potentiometer P1. This allows 30 micro seconds settling time for the remote interface address before the flip flop U8A is set by the counter output Q1, producing ENABLE signal for analog bus ENABLE. A settling time of 180 micro seconds (6 x 30 micro seconds) is allowed for the analogue bus, before the A/D conversion is started by the U5 counter output, Q7 generating CC signal.

The next pulse Q8 enables vias gate U15D the EOC (end of conversion) signal to generate the IN CLOCK signal, clocking the A/D output in the computer input interface.

### Adjustments

With the computer in the "osciloscope" loop mode, adjust the oscilator V6 output (PIN 3) to 30 micro second period with potentiometer P1 and aid of an osciloscope.

## 7.5 Driver Modules

Driver modules are converting 0-5V logic signals to 0-15V 100MA signals driving the analogue bus addresses and controls, providing as well LED visual indicators (figs. 7.5 and 7.6).

## 7.6 Alarm and Monitoring Module

The alarm and monitoring module provides a visual display of status of alarms A, B and C via LED indicators. Alarms A and C are transmitted as well via relay contacts RA and RC respectively. Two push buttons are provided for the reset of alarms B and C. Relay RW monitors power supplies in the remote terminal boxes indicating loss of power from a bin supply. A loop break of the analogue bus is indicated via relay KLB. Four additional LED indicators, driven directly by the analogue bus signals, indicate the presence of REAL and PEAK signals (fig. 7.7).

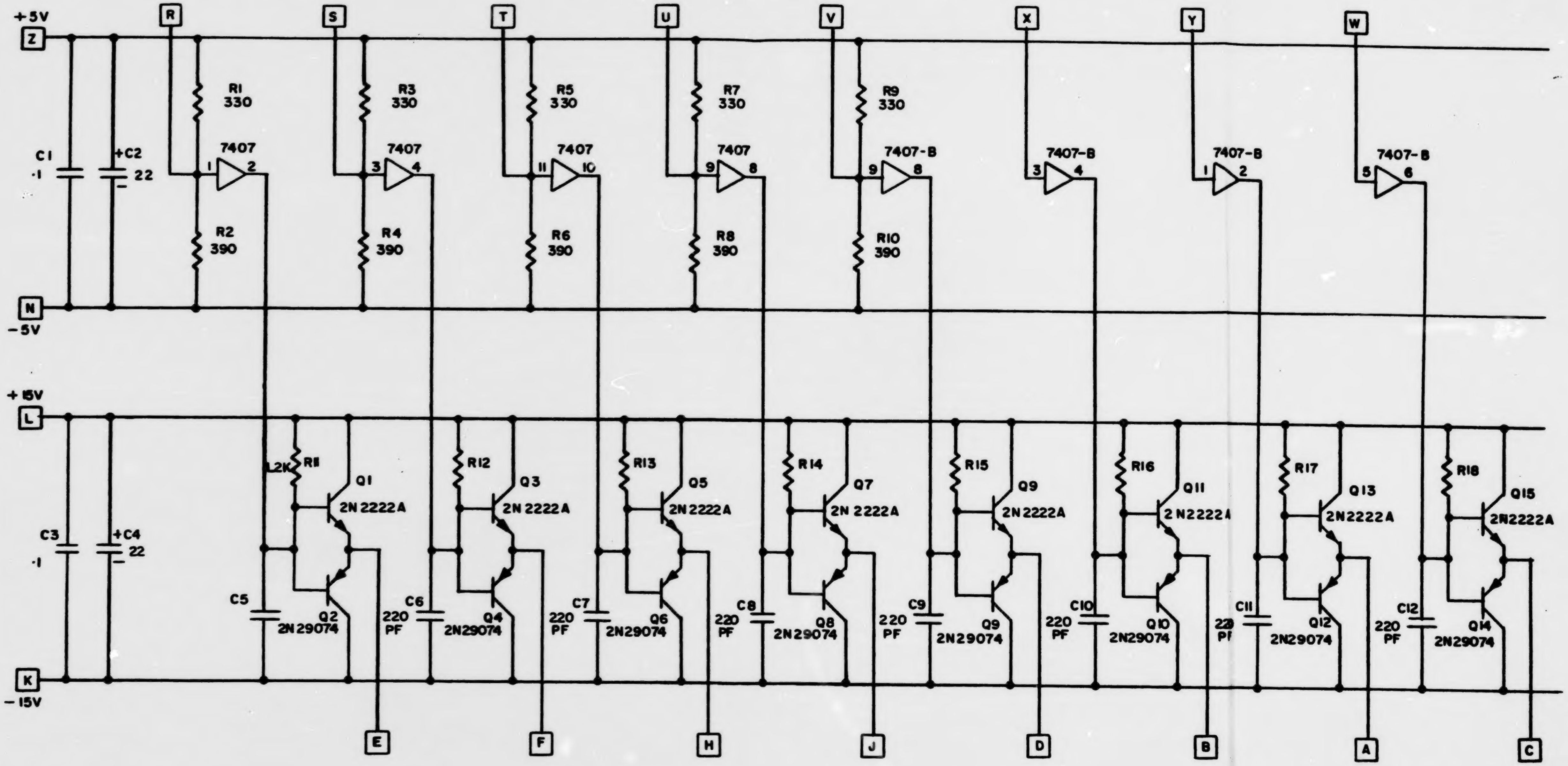

+5V
Z
R
S
T
U
V
X
Y
W
R1 330
R3 330
R5 330
R7 330
R9 330
C1 .1
+C2 22
7407
7407
7407
7407
7407-B
7407-B
7407-B
7407-B
1 2
3 4
11 10
9 8
9 8
3 4
1 2
5 6
R2 390
R4 390
R6 390
R8 390
R10 390
N
-5V
+15V
L
1.2K R11
R12
R13
R14
R15
R16
R17
R18
Q1 2N2222A
Q3 2N2222A
Q5 2N2222A
Q7 2N2222A
Q9 2N2222A
Q11 2N2222A
Q13 2N2222A
Q15 2N2222A
C3 .1
+C4 22
C5
C6 220 PF
C7 220 PF
C8 220 PF
C9 220 PF
C10 220 PF
C11 220 PF
C12 220 PF
Q2 2N29074
Q4 2N29074
Q6 2N29074
Q8 2N29074
Q9 2N29074
Q10 2N29074
Q12 2N29074
Q14 2N29074
K
-15V
E
F
H
J
D
B
A
C

FIG. 7.5
LOGIC DIAGRAM DRIVER MODULE Nº 1
(MAIN INTERFACE)

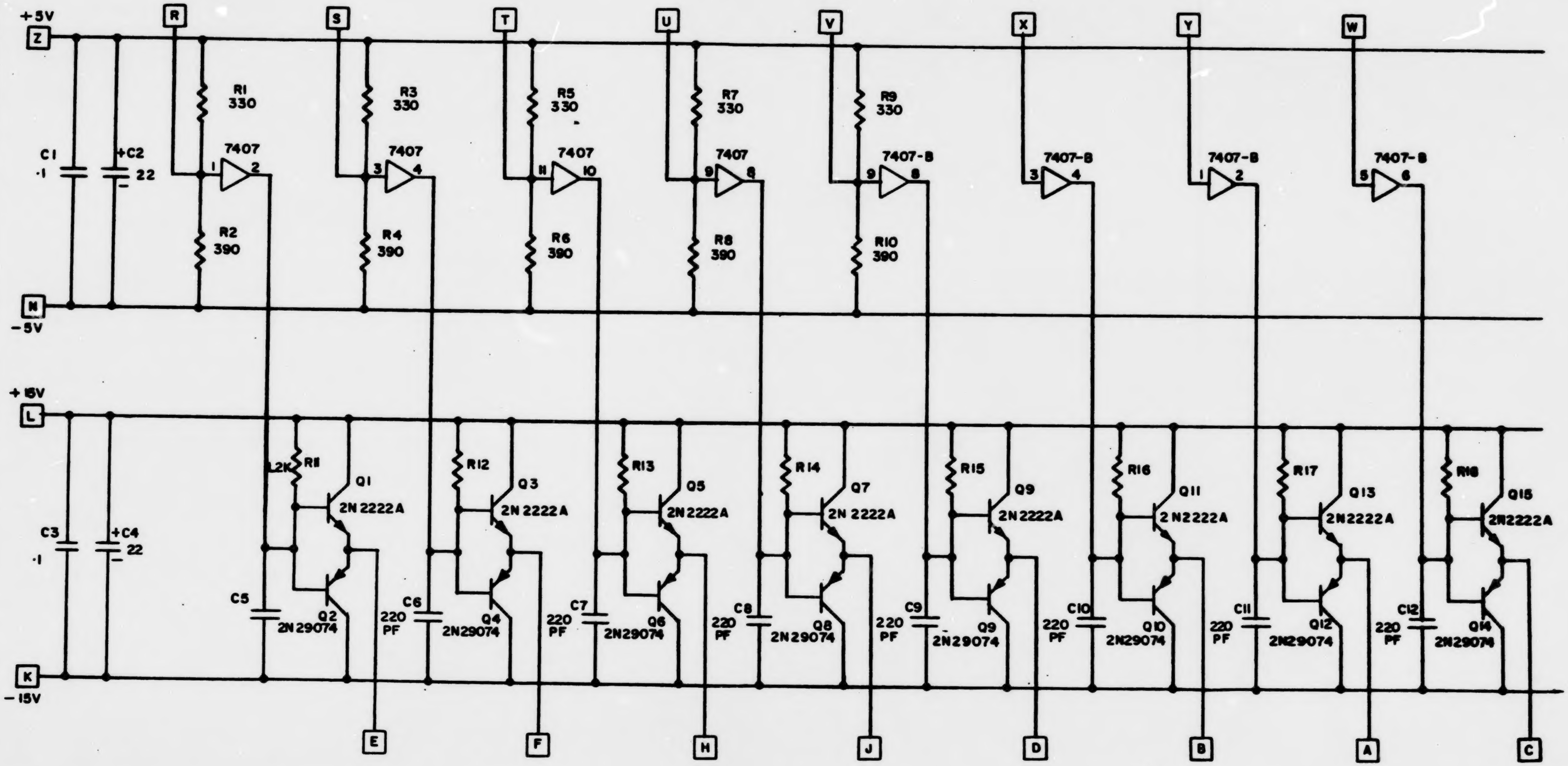
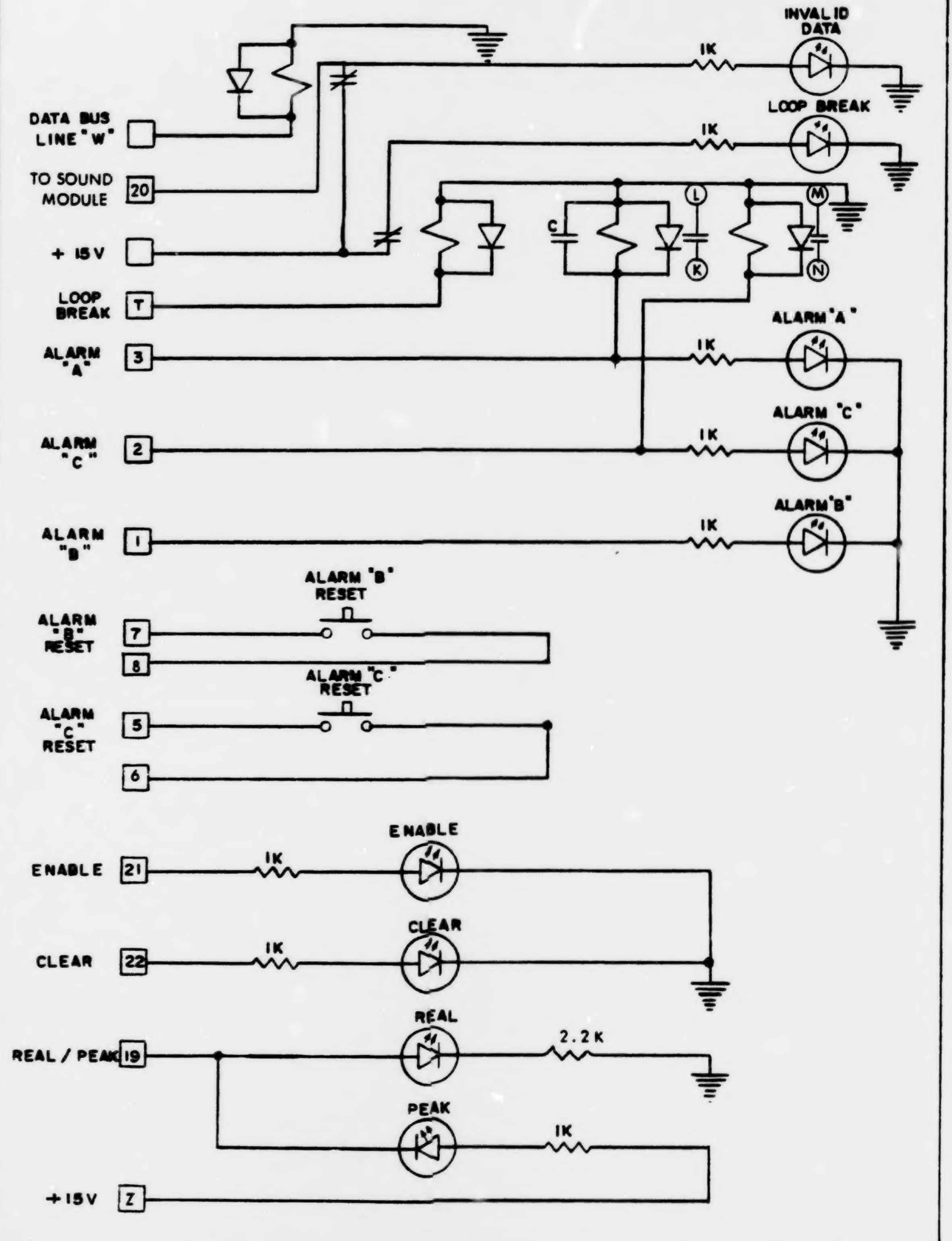

+5V
Z
R
S
T
U
V
X
Y
W
R1 330
R3 330
R5 330
R7 330
R9 330
C1 .1
+C2 22
7407
7407
7407
7407
7407-B
7407-B
7407-B
7407-B
1 2
3 4
11 10
9 8
9 8
3 4
1 2
5 6
R2 390
R4 390
R6 390
R8 390
R10 390
N
-5V
+15V
L
1.2K R11
R12
R13
R14
R15
R16
R17
R18
Q1
Q3
Q5
Q7
Q9
Q11
Q13
Q15
2N2222A
C3 .1
+C4 22
C5
C6 220 PF
C7 220 PF
C8 220 PF
C9 220 PF
C10 220 PF
C11 220 PF
C12 220 PF
Q2
Q4
Q6
Q8
Q9
Q10
Q12
Q14
2N29074
K
-15V
E
F
H
J
D
B
A
C

FIG. 7.6

LOGIC DIAGRAM, DRIVER MODULE Nº 2
(MAIN INTERFACE)


INVALID DATA
IK
LOOP BREAK
IK
DATA BUS LINE "W"
TO SOUND MODULE
20
+ 15 V
LOOP BREAK
T
C
L
K
M
N
ALARM "A"
3
IK
ALARM "A"
ALARM "C"
2
IK
ALARM "C"
ALARM "B"
1
IK
ALARM "B"
ALARM "B" RESET
ALARM "B" RESET
7
8
ALARM "C" RESET
ALARM "C" RESET
5
6
ENABLE
21
IK
ENABLE
CLEAR
22
IK
CLEAR
REAL / PEAK
19
REAL
2.2K
PEAK
IK
+15V
Z

LOGIC DIAGRAM, ALARM AND MONITORING MODULE (MAIN INTERFACE)

FIG. 7.7

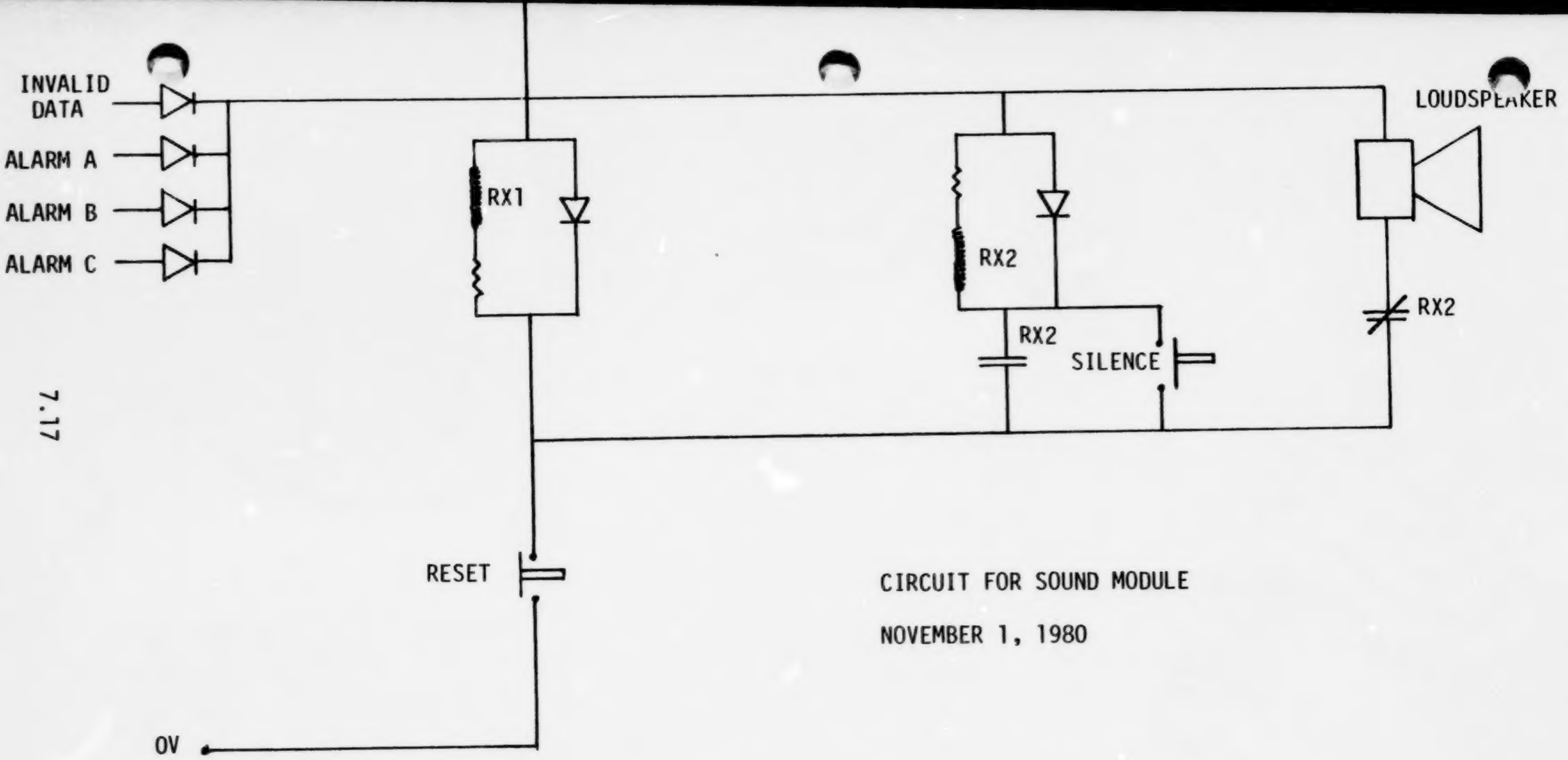
## 7.7 Sound Module

The sound module provides an audible alarm in the event of INVALID DATA, ALARM A, ALARM B or ALARM C. Setting relay RX1 via diodes D1 to D4 respectively. The relay RX1 latches itself via its N/O contact and provides power for the buzzer (fig. 7.8).

The SILENCE (Disable) push button latches relay RX2, de-energizing RX1 and buzzer. The RESET push button resets relay RX2 which in turn re-arms alarm monitoring relay RX1.

## 7.8 Power Module

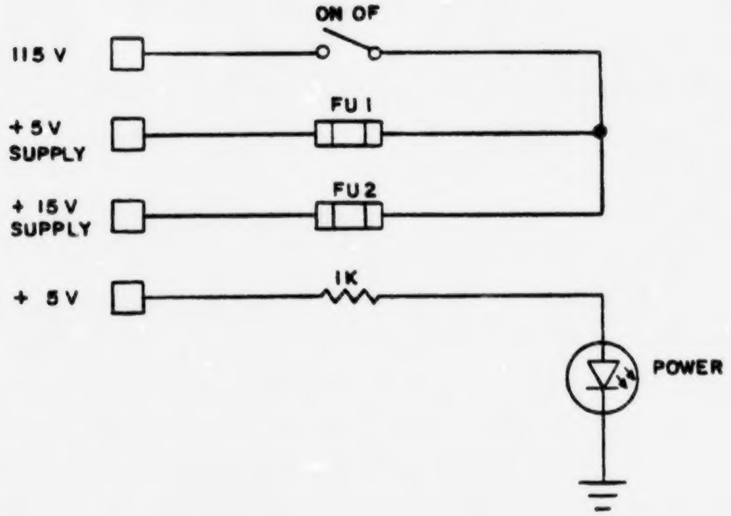
The power module consists of two fuses for +5V and +15V power supply, a ON/OFF switch for 115V 60HZ input power, and a LED indicator powered from +5V power supply to indicate POWER ON (fig. 7.9).


INVALID DATA
ALARM A
ALARM B
ALARM C
RX1
RX2
RX2
SILENCE
LOUDSPEAKER
RX2
RESET
OV

CIRCUIT FOR SOUND MODULE

NOVEMBER 1, 1980

FIG. 7.8


ON OF
115 V
FU 1
+ 5 V
SUPPLY
FU 2
+ 15 V
SUPPLY
1K
+ 5 V
POWER

MAIN INTERFACE - POWER MODULE

FIG. 7.9

## 7.9 Description of the Old Interface Circuit (Fig. 13)

Although the layout of the new interface is different, its operation is essentially the same as the old interface described here.

The interface circuit provides the necessary timing controls and drive circuits to operate the data logging system in conjunction with the Rolm 1608A computer. It can operate in any one of three modes; data, alarm, or zero. These will be discussed separately, following a brief summary of the computer signals.

### Summary of Computer Signals

The computer containing a #8540 16-bit parallel input-output (IO) buffer card. Functionally, this buffer is between the central processor and the connector linking the "computer" to the outside world. When the computer is being used for programming, the IO card must be replaced by a floppy disc control card, but for purposes of this discussion, the IO card will be considered an integral part of the computer.

Panel connector J8 accommodates all signals to and from the outside world. These include 16 data output lines (DO0-DO15, 16 data input lines (DI0-DI15), and 4 control signals (out busy, in busy, ext. gate, and INCLK) whose functions will be described. The control signals operate with "negative logic", i.e. low levels or falling edges control operations. Accordingly, these signals are shown with a negation bar (i.e. outbusy) on schematics and timing diagrams, but the bar is omitted in the descriptive text.

Data Mode (Fig. 7.10)

This is the normal operating mode, whereby the computer obtains data from a single channel upon request. For the following explanation, refer to Timing Diagram #1. When the computer wants to obtain data, it sends OUT BUSY, IN BUSY, and a 10 line address. (The address, however, does not appear on the connector lines until output gates on the IO card are enabled externally). OUT BUSY and IN BUSY occur within a few μS of each other, and are considered to be simultaneous at t = 0. (All times are in micro-seconds).

The falling edge of OUT BUSY, inverted, sets FF1, whose pin 2 output drives EXT GATE Low and gates the address onto the output connector lines D015-D06. A set of 10 buffers drives this address onto the system bus as 5 box address lines, 4 card address lines, and a real/peak selection line. The falling edge of IN BUSY at t = 0, inverted, sets FF9; the pin 12 output goes low and the pin 13 output goes high and enables the 100kHz clock (IC13) to start running. The clock has a 10 μS period and drives a Johnson counter (IC11); the first rising edge occurs at t = 5 and sets the "1" output high, and the second rising edge at t = 15 sets the "2" output high. The "2" output sets FF10, whose output drives the EN line high.

Thus, we have a 15μS delay between sending an address, and sending EN which allows the cards to respond to the address; this gives time for ringing on the address lines to settle out and prevents random addresses from responding. At t = 15, the card whose address has been sent is enabled, and connects its signal onto the analog bus. The bus must be driven from a zero condition to the proper signal level, and this takes on the order of 50μS , due primarily to slow rate limits in the amplifiers.

At t = 95, the CO signal of the Johnson counter goes high. This drives the convert command (CC) line of the analog-to-digital convertor low and initiates a conversion. The conversion takes approximately 8 μs, and when it is complete at t = 103 the EOC lines goes low. This signal, inverted, sets FF11. The rising edge of FF11's output drives IN CLK low, causing the computer to read in the digital value from the convertor on lines DI15-D16. The falling edge of IN CLK also resets IN BUSY (within the computer) to the high state.

The high level from FF11 also initiates a reset sequence within the interface circuit. It resets FF10, which drives the EN line low. It also resets FFF9: the pin 13 output goes low and disables the clock: the pin 12 output goes high and resets the Johnson counter, and sets FF8. FF8 resets FF1's pin 2 output and EXT GATE to a high state; the rising edge of EXT GATE resets (within the computer) OUT BUSY to a high state, and the high level of EXT GA TE disables the output gates on the IO card. The data mode sequence is now complete, and a new one can be initiated by the computer when desired.

Please note that an option exists with respect to the amount of time allowed for the address lines to settle. In the above description, the E11 line (FF10) was driven by the "2" output (pin 4) of the Johnson counter, giving 15 s for the analog bus to settle (t = 15 to t = 95), and 80 μs for the analog bus to settle (t = 15 to t = 95). It is also possible to drive the EN line by the "3" output (pin 7), which gives 25 μs for the address lines to settle, but only 70 μs for the analog bus to settle. This change is made by means of a jumper on the printed circuit board. The "1" output (pin 2) is also available, but is not likely to be used.

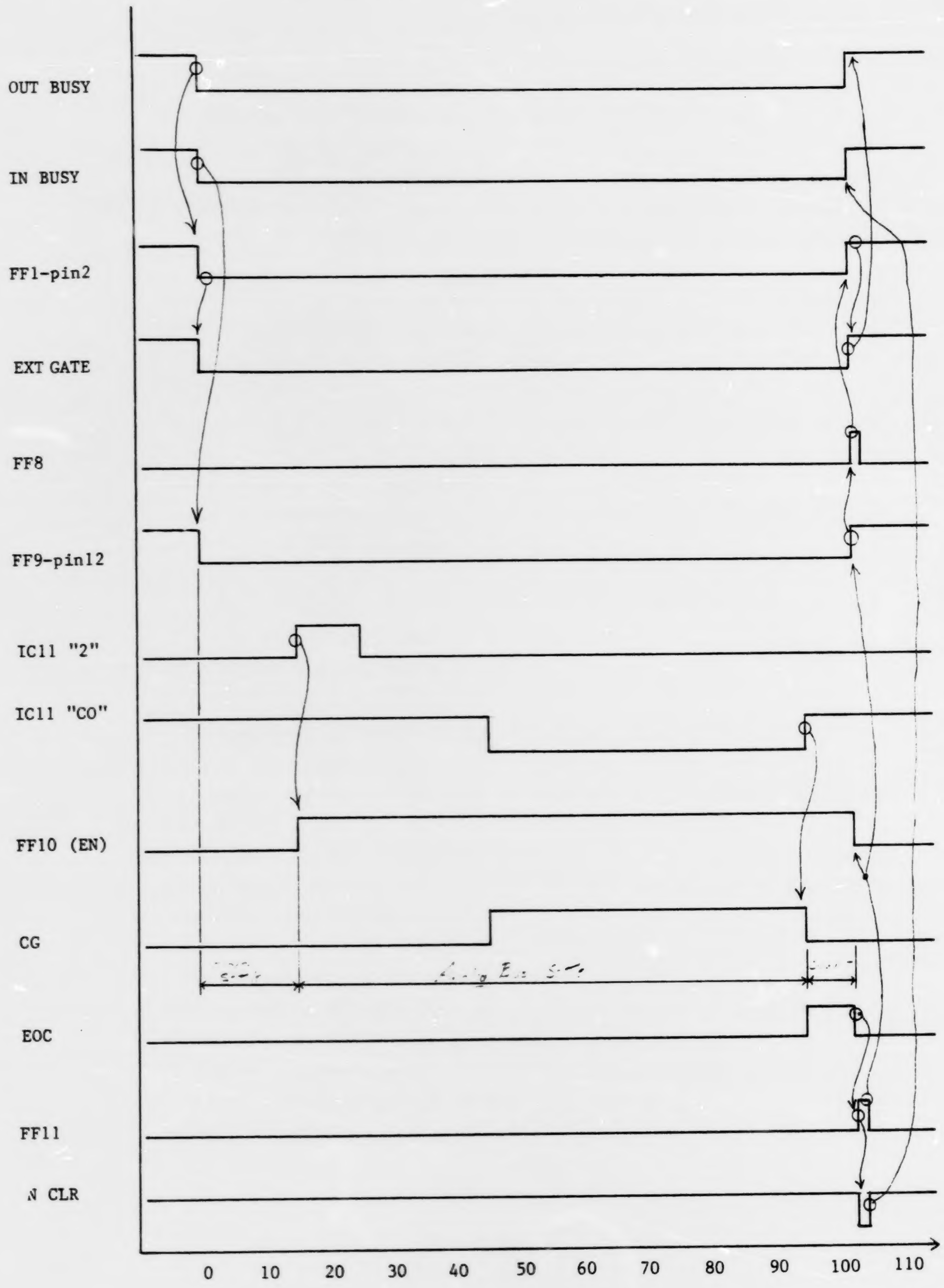

OUT BUSY
IN BUSY
FF1-pin2
EXT GATE
FF8
FF9-pin12
IC11 "2"
IC11 "CO"
FF10 (EN)
CG
EOC
FF11
N CLR
0
10
20
30
40
50
60
70
80
90
100
110

FIG. 7.10

Alarm Mode (Fig. 7.11)

The computer is programmed to check for any one of three abnormal conditions; if one occurs, the interface circuit takes appropriate action. The conditions and resulting actions are listed below:

1. If the returning data from any channel is outside high and low limits established by the operator (Alarm "A"), the interface issues a 100 μs pulse.

2. If the returning data from a single specified channel is outside high and low limits established by the operator (Alarm "B"), the interface latches a relay and lights an external lamp. The relay contacts are available for external use, and the latch can only be manually reset.

3. If either Ampex tape drive runs out of tape (Alarm "C"), a flip-flop is set. This lights an external lamp, and can only be manually reset.

The operation of the alarm circuits is described below.

If any of the alarm conditions is detected, the computer initiates an alarm mode cycle by sending OUT BUSY and one of three data lines (D04, D03, or D02) corresponding to "A", "B", or "C" alarms. Notice that an IN BUSY is not sent, so no data conversion is initiated. Refer to timing diagram #2.

The falling edge of OUT BUSY, inverted, sets FF1 at t = 0. The pin 2 output drives EXT GATE low, which enables the output gates on the IO card; the pin 1 output triggers FF2, a monostable which generates a 1 μs pulse. Assume that alarm condition "A" is present, causing D04 to be high. The rising edge of the pulse from FF2, at t = 1, triggers FF3, a monostable which generates a 100 μs pulse. This pulse is buffered and sent to the "Alarm A" output. Notice that FF4 and FF5 are not triggered, because their corresponding lines, D03 and D02, are low. It would be possible to use the end of the 100 s pulse to reset OUT BUSY, etc, but this approach would tie up the computer for 101 μs, a needlessly long time. Instead, a gate (IC5) detects that one of the alarm conditions is present and sends a high level to the data input of FF6; when the rising edge of the pulse from FF2 pin 1 occurs at t = 1, this triggers FF6. FF6 in turn generates a 1 μs pulse, whose rising edge, at t = 2, triggers FF8, a monostable which generates a 1 μs pulse. This pulse resets FF1 at t = 2, returning EXT GATE to a high state. As in the data mode, the rising edge of EXT GATE resets (within the computer) OUT BUSY, and the high level disables the address gates on the IO card. Thus, the computer is tied up for only 2 μs, while the "Alarm A" signal is sent for 100 μs.

Alarm "B" and "C" conditions will latch FF4 or FF5, respectively, and these require manual reset. In either case, however, the gate (IC5) ensures that the computer is reset in 2 μs.

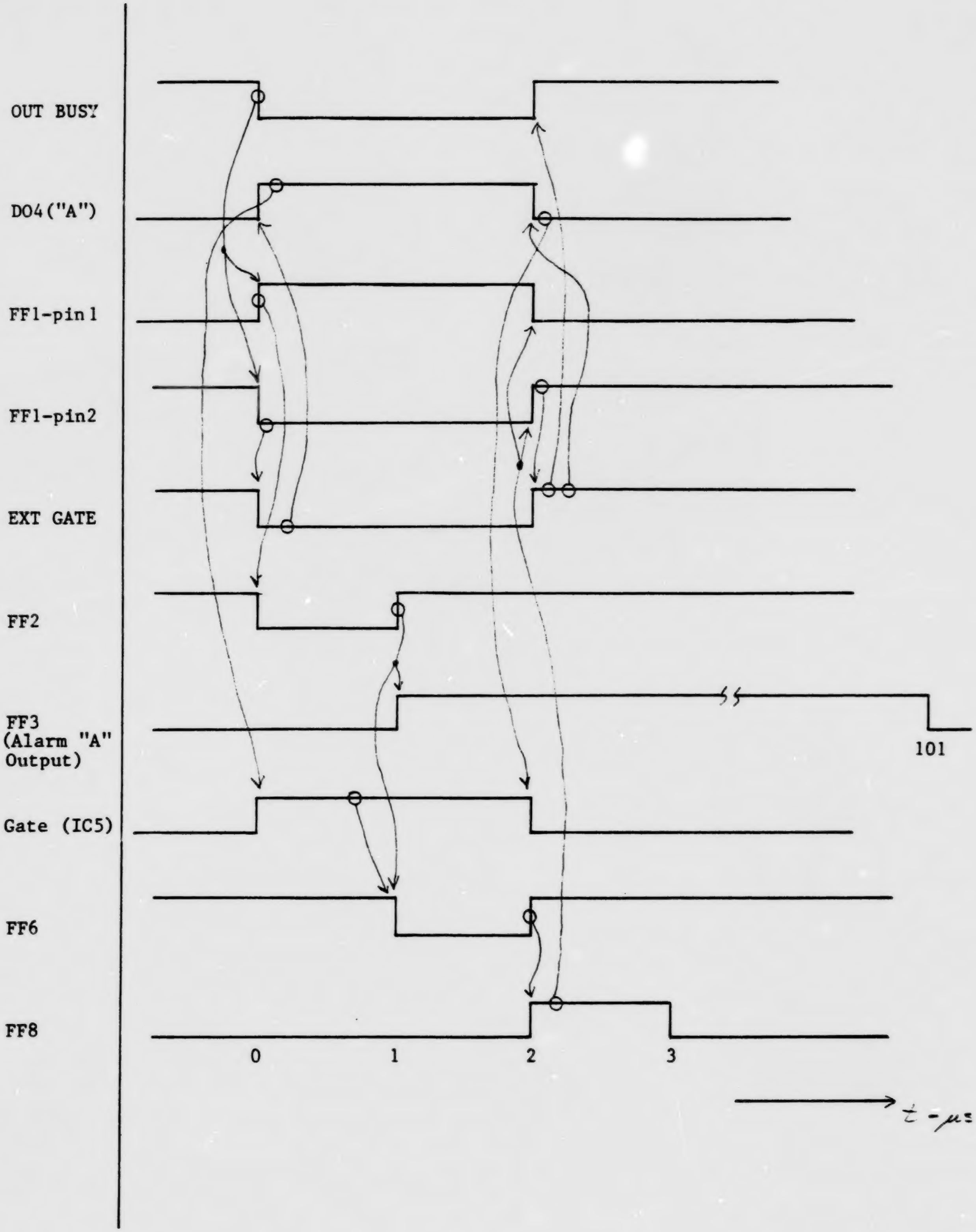

OUT BUSY
DO4("A")
FF1-pin 1
FF1-pin2
EXT GATE
FF2
FF3
(Alarm "A"
Output)
101
Gate (IC5)
FF6
FF8
0
1
2
3
t - μs

FIG. 7.11

Zero Mode (Fig. 7.12)

The individual channels contain amplifiers which are subject to drift with time and/or temperature. Since this drift is indistinguishable from actual data, the amplifiers must be periodically re-zeroed. This is done under computer control once per minute. Refer to Timing Diagram #3.

The computer issues an OUT BUSY and a high level on DO5. In the same manner as previously described, EXT GATE is driven low at t = 0 and enables the output gates on the IO card. FF2 issues a pulse whose rising edge occurs at t = 1, and since DO5 is high, this triggers FF7. FF7 is a milli-second monostable. Its output pulse is buffered and drives the CLR bus line, which controls the auto-zero function of all channels simultaneously. After 1 milli-second, the rising edge of the CLR pulse sets monostable FF8, whose output resets FF1. This resets EXT GATE, which resets OUT BUSY, and disables the output gates as previously described.

Notice that in zero mode the computer is tied up for 1 milli-second. This is done intentionally, so that the computer cannot issue a request for data during the time that the channels are re-zeroing.

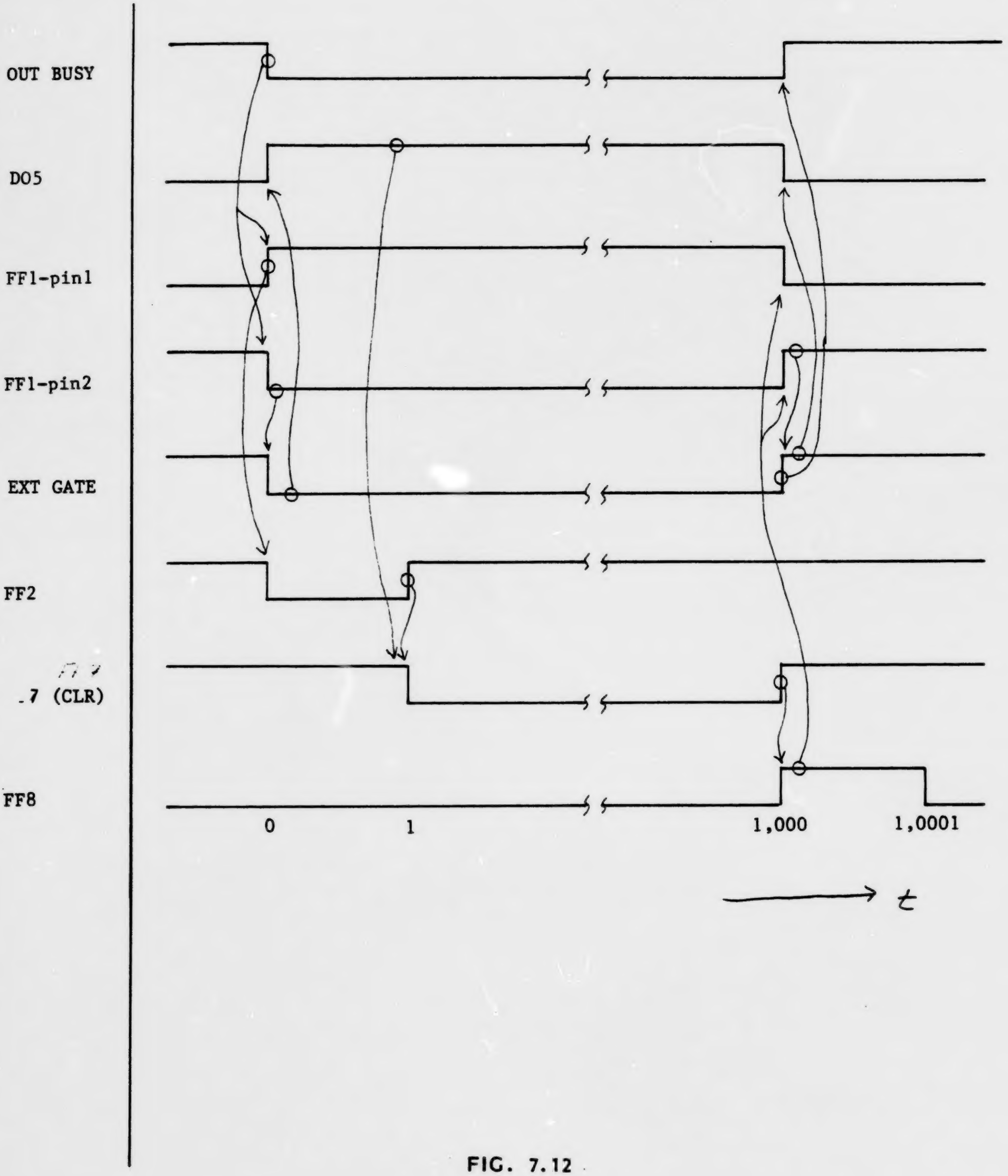

OUT BUSY
DO5
FF1-pin1
FF1-pin2
EXT GATE
FF2
FF7 (CLR)
FF8
0
1
1,000
1,0001
t

FIG. 7.12

## Fail-Safe Circuits

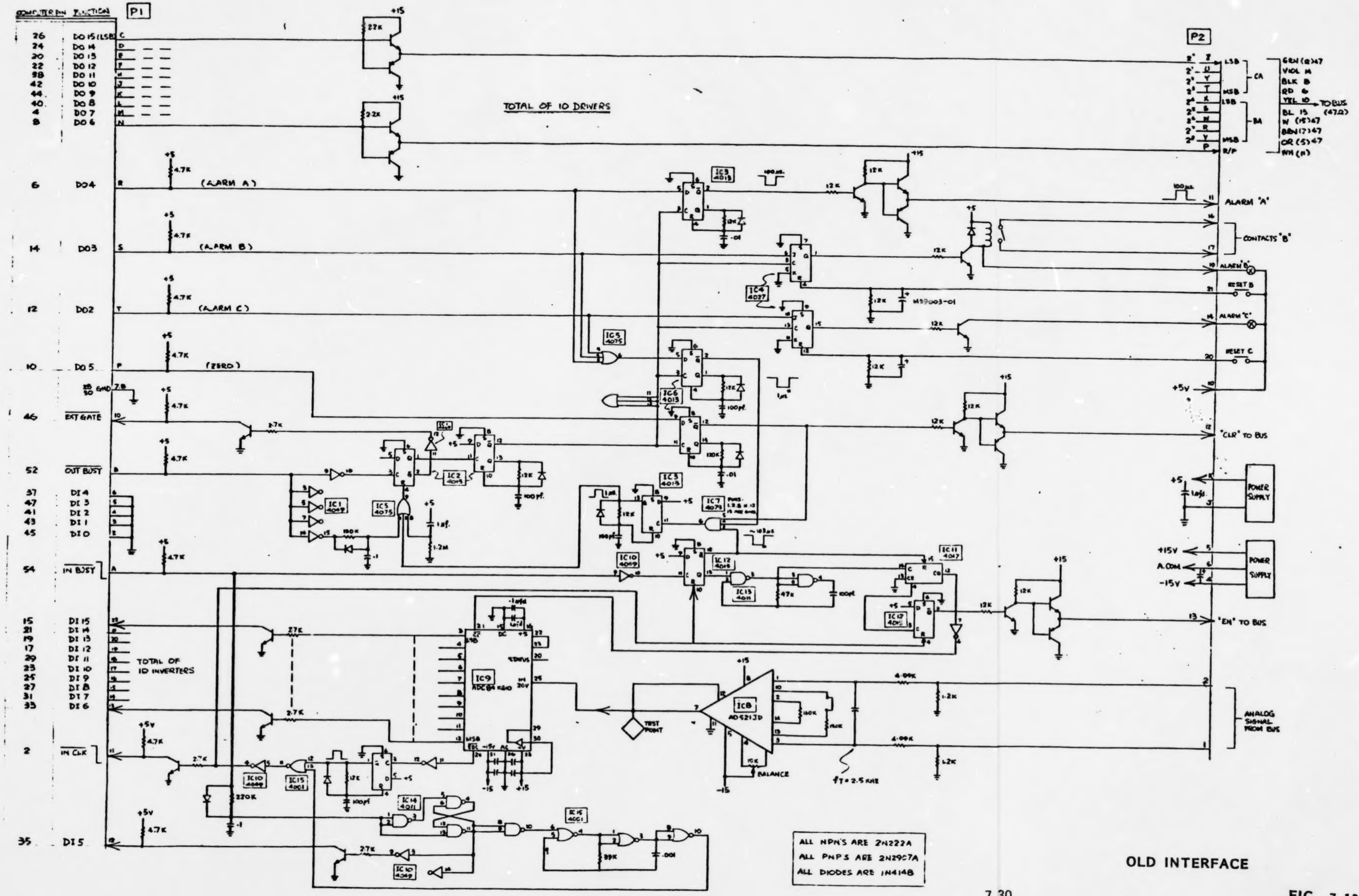
The foregoing descriptions have covered the normal operation of the various modes. It can be seen that the computer is tied up for times ranging from 2 $\mu$s to 1 milli-second, and requires the interface to issue certain signals before it can proceed with further data requests. In the event that the interface failed to operate normally, the computer could be tied up for an indefinite period. To prevent this situation, the interface contains several circuits which back up the normal operation.

Normally, the computer issued IN BUSY when it wants data, and waits for the interface to issue IN CLK which resets IN BUSY. If any link in the data conversion sequence were to fail (for example, if FF9 failed to set), no conversion would occur and IN CLK would not be issued in the expected 103 s, and the computer would be tied up. This is prevented in the following manner. IN BUSY is normally high, and capacitor C13 at the input of Schmitt trigger IC14 is charged. When IN BUSY goes low, C13 starts to discharge. After approximately 20 milli-seconds, it will discharge to the point where the Schmitt trigger changes stage. This places a high level on D15 and starts a clock (IC15). The clock will pulse IN CLK (repetitively, if necessary); this causes the computer to read in the high level in D15, which alerts the program to the fact that the fail-safe circuit has come into operation, and reset IN BUSY.

If the computer detects an alarm condition, it normally issues OUT BUSY and one of the alarm lines (DO4, DO3, or DO2). If for some reason none of the alarm lines were activated, the gate IC5 would not trigger FF6 to start the reset sequence, and the computer would be tied up. This is prevented in the following manner. OUT BUSY is normally high, and IC1 pin 15 is normally low. When OUT BUSY occurs, pin 15 goes high and capacitor C3 starts to charge. If OUT BUSY is not reset in the expected 2 $\mu$s, in about 10 milli-seconds C3 charges to the point where it turns on IC5 pin 1, and resets FF1.

The above circuit also comes into operation if the expected reset does not occur in 1 milli-second following a zero command.

When power is first applied to the interface circuit, it could turn on with FF1 already set. In that case, FF1 would ignore any subsequent OUT BUSY signals which the computer might issue. To prevent this, capacitor C2 at IC5 pin 8 holds the gate input high for about 1 second, applying a high to the reset of FF1 and preventing it from turning on in the set condition.


COMPUTER PIN FUNCTION
P1
P2
TOTAL OF 10 DRIVERS
(ALARM A)
(ALARM B)
(ALARM C)
(ZERO)
EXT GATE
OUT BUSY
IN BUSY
IN CLK
TOTAL OF 10 INVERTERS
ALARM "A"
CONTACTS "B"
RESET B
ALARM "C"
RESET C
"CLR" TO BUS
POWER SUPPLY
"EN" TO BUS
ANALOG SIGNAL FROM BUS
TO BUS
TEST POINT
BALANCE
AD521JD
ADC 84-10
ALL NPN'S ARE 2N222A
ALL PNP'S ARE 2N2907A
ALL DIODES ARE 1N4148

OLD INTERFACE

FIG. 7.13

COMPUTER INTERFACE PCB-7812

# SECTION 8

# COMPUTER SYSTEM

## 8.1 Computer System (Fig. 8.1)

The heart of the system is a Rolm Model 1603A Computer (Serial No. 1023) which has 32K of memory, a real time clock and space for 6 I/O boards. These are used as follows:

1. Interface (Floppy)
2. Tape: Check Logic
3. Tape: Counter Buffer Modified
4. Tape: I/O Control
5. Tape: Transport Logic
6. Terminal

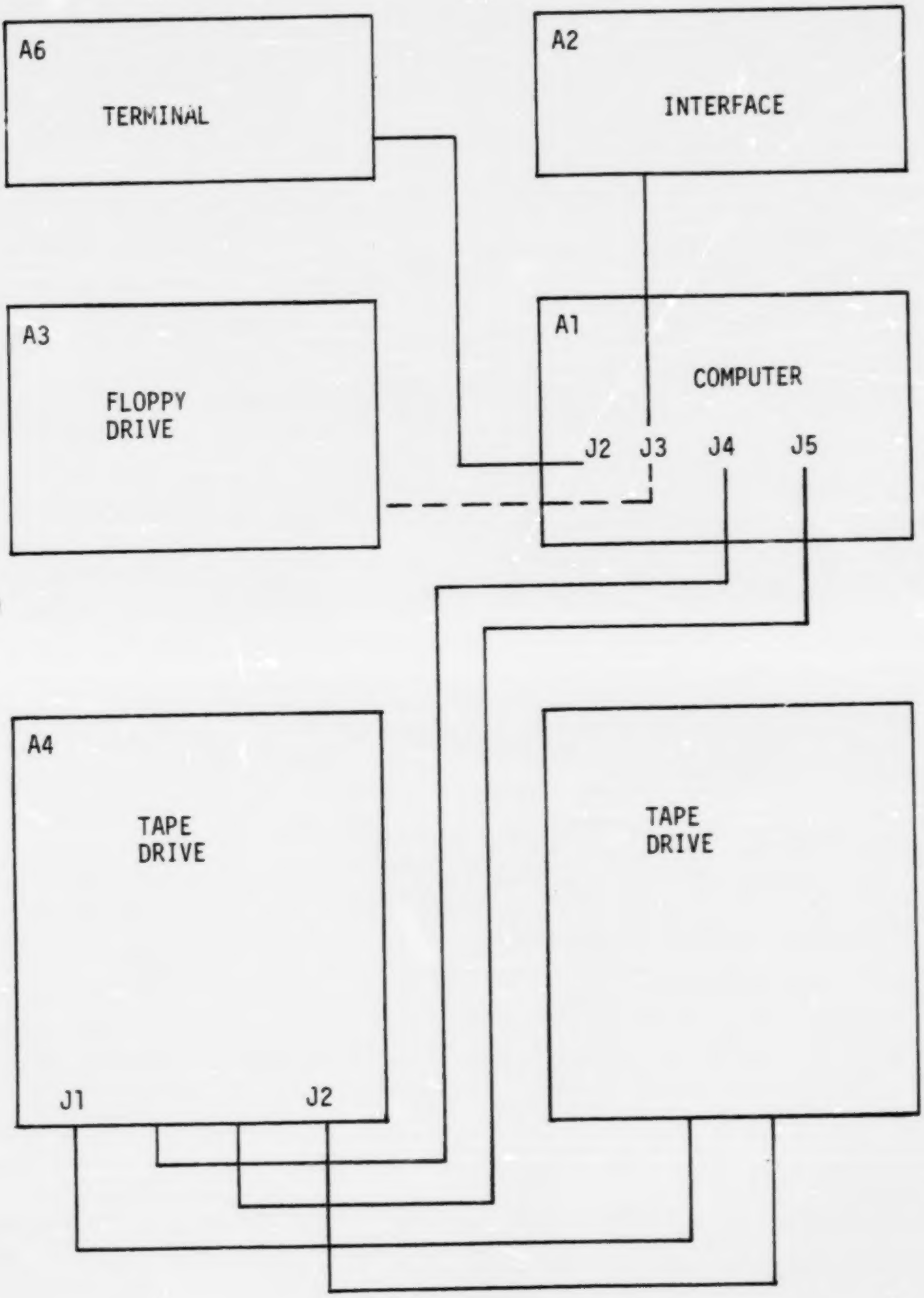
Use of more I/O boards is possbile with an extender chassis. An interface I/O board is normally plugged into slot 1 (slot nearest rear of chassis) and to use the floppy drives, this board must be replaced with a floppy I/O board and the cable from the floppy connected to J3 in place of the cable from the interface.

Peripheral equipment comprises 2 Ampex Model TMA Tape Drives, a Rolm model 3383 floppy disc system, and a Rolm Model 3315 terminal printer. This equipment suffers from problems with dirt coming in through the ventilation system and should be cleaned regularly; especially the heads and lights and photocells of both the Tape and Floppy drives which should be cleaned with Isopropyl alcohol.

Separate manuals are held for all the computer equipment.

FIG. 8.1

COMPUTER SYSTEM CONNECTIONS


A6
TERMINAL
A2
INTERFACE
A3
FLOPPY DRIVE
A1
COMPUTER
J2
J3
J4
J5
A4
TAPE DRIVE
J1
J2
TAPE DRIVE

NOTE: 'REWIND' LEADS TO TAPE DRIVES DISCONNECTED JULY 1980 TO OVERCOME TAPE PROBLEMS

# PART III

# CLOSED CIRCUIT TELEVISION SYSTEM

## LIST OF FIGURES

### Part III

Fig. T.V. 1 T.V. Wiring

Fig. T.V. 2 Closed Circuit T.V. System: Zoom Control

Fig. T.V. 3 Closed Circuit T.V. System: Pan Control

Fig. T.V. 4 Closed Circuit T.V. System: Camera Power

## Closed Circuit Television System (Fig. TV.1)

A CCTV system is installed with the camera on the forward observation tower and monitors on the bridge and in the laboratory. The display may be recorded on the video tape recorder, and provision is made for recording on command from the computer as well as the normal manual operation. Playback can be displayed on the left hand monitor without interfering with the displays on the right hand monitor and the monitor on the bridge. Time and date can be superimposed on the display.

Controls are available in the laboratory and on the bridge for adjusting the camera lens and the camera direction. A switch in the laboratory selects which set of controls are on line. The major threat to serviceability of the CCTV system is corrosion, and consequently great care must be taken when making connections and closing exposed boxes to ensure that they are adequately sealed. Exposed equipment will be subjected to spray and occasionally to water from all directions. Power should be turned off and a cover placed over the camera if heavy weather is anticipated.

## 1. Introduction

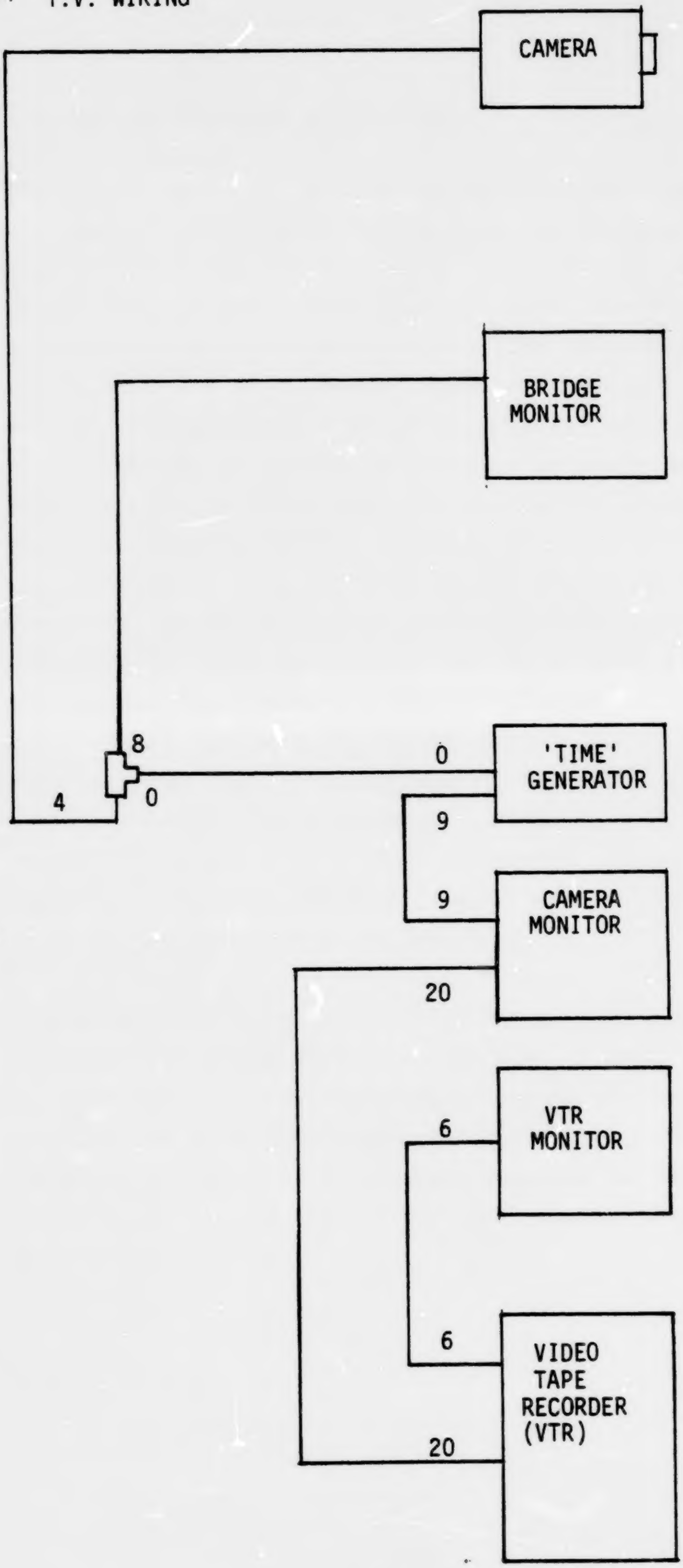
The system consists of the following major components:

- PANASONIC Model WV-1050 Television Camera
- CANON TV Zoom Lens J6 X 12REA (DC)
- VICON Model V106AC Auto Iris and Zoom Lens Control
- VICON Model V800H Environmental Enclosure
  - complete with Model V800-H Heater
  - Model V800-B Blower

- VICON Model V300-115PT Pan and Tilt Drive
- VICON Model V110PT Pan and Tilt Controls
- PANASONIC Model NV-8030 Time Lapse Video Tape Recorder
- PANASONIC Model TN-932 "Type 9" High Resolution Monitor TV
- PANASONIC Model WV-5301 Video Monitor
- PELCO Model TDG-100 Video Time/Date Generator

Company supplied technical literature on each of these items is included at the end of this section.

FIG. TV.1 T.V. WIRING


CAMERA
BRIDGE MONITOR
8
0
4
0
'TIME' GENERATOR
9
9
CAMERA MONITOR
20
6
VTR MONITOR
6
VIDEO TAPE RECORDER (VTR)
20

## 2. T.V. System: Operation of Controls

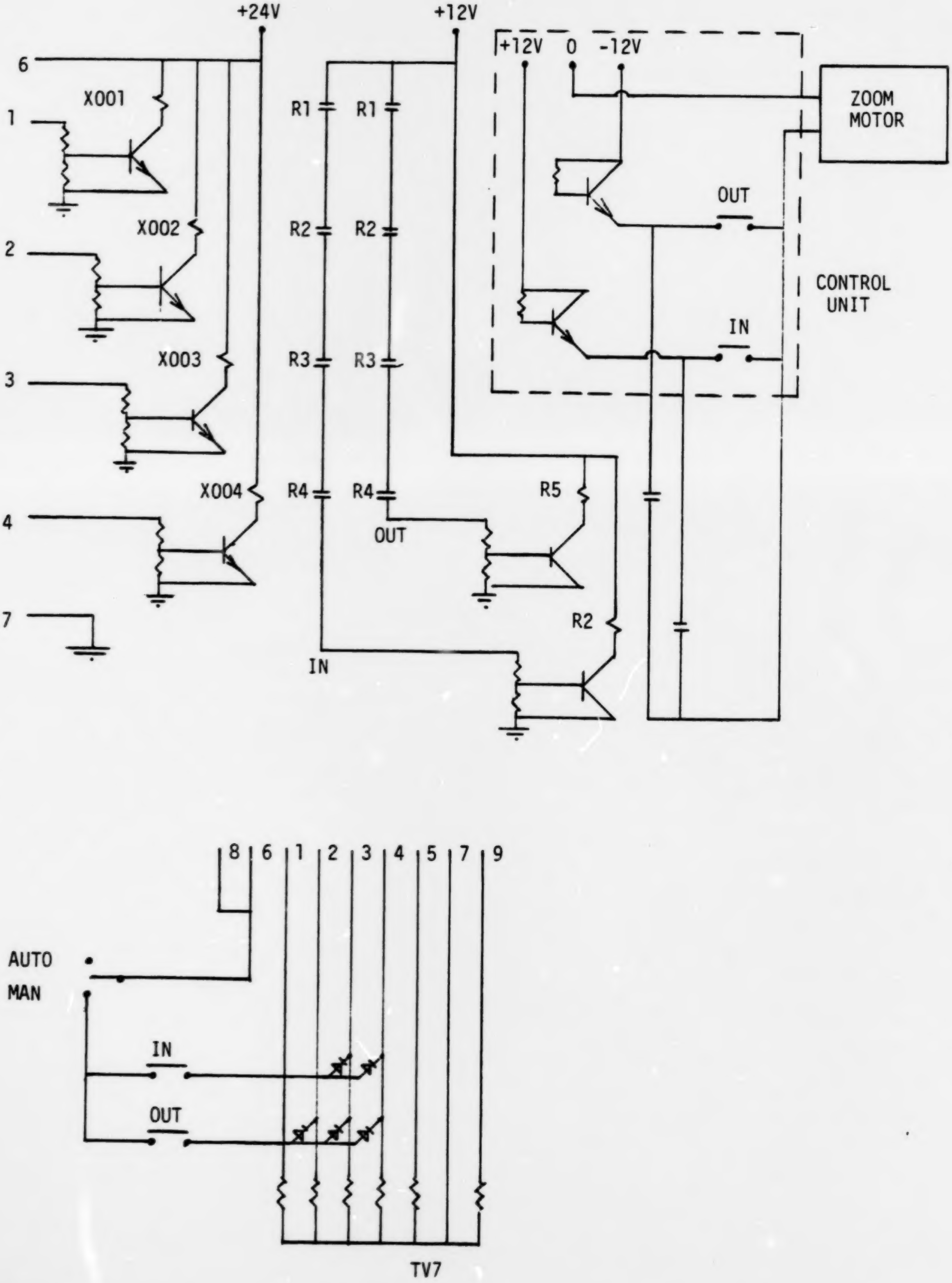
The control cable and switches in the laboratory (and on the bridge) are part of a 24V circuit powered from the supply in the camera housing. Pushing the control button switches +24V through 1 or more diodes onto the appropriate control lines. (In automatic mode, this switching is done by timer relays.) The appearance of this voltage at the other end of the control lines switches on the driver transistors so putting current through the required relays (R1 to R4) Table TV.1. Opening or closing of contacts on these relays completes a +12V circuit to a slave relay controlling the function requested. If the control is for forward operation of a motor (say Zoom In), then the controlling relay switches a +12V supply to the motor, Figure TV.2. If the control is for reverse operation of a motor (say Zoom Out), then a (different) controlling relay switches a -12V supply to the motor. For directional control operation of the required slave relay closes contacts in a +24V circuit to a power relay which switches 24Vac through to the pan or tilt motor, Figure TV.3. Both these are synchronous motors with one winding supplied direct and the second winding supplied through a capacitor so that its current leads the first. Changing the direct supply from one winding to the other reverses the direction of the motor.

Giving the 'Camera On' command results in operation of a slave relay which briefly closes in a latching relay circuit. This relay stays on until reset by the 'Power Off' command and makes contacts in a +24V circuit to a power relay which switches 115Vac through to the camera. An identical arrangement switches on the blower which is switched off by the same 'Power Off' command used for the camera, Figure TV.4.

| FUNCTION | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Iris OPEN | 0 | 0 | 0 | 1 |
| Zoom IN | 0 | 0 | 1 | 1 |
| Focus NEAR | 0 | 0 | 1 | 0 |
| Iris CLOSE | 0 | 1 | 1 | 0 |
| Zoom OUT | 0 | 1 | 1 | 1 |
| Focus FAR | 0 | 1 | 0 | 1 |
| Tilt UP | 0 | 1 | 0 | 0 |
| Tilt DOWN | 1 | 1 | 0 | 0 |
| Pan STBD | 1 | 1 | 0 | 1 |
| Pan PORT | 1 | 1 | 1 | 1 |
| CCTV ON | 1 | 1 | 1 | 0 |
| Blower ON | 1 | 0 | 1 | 0 |

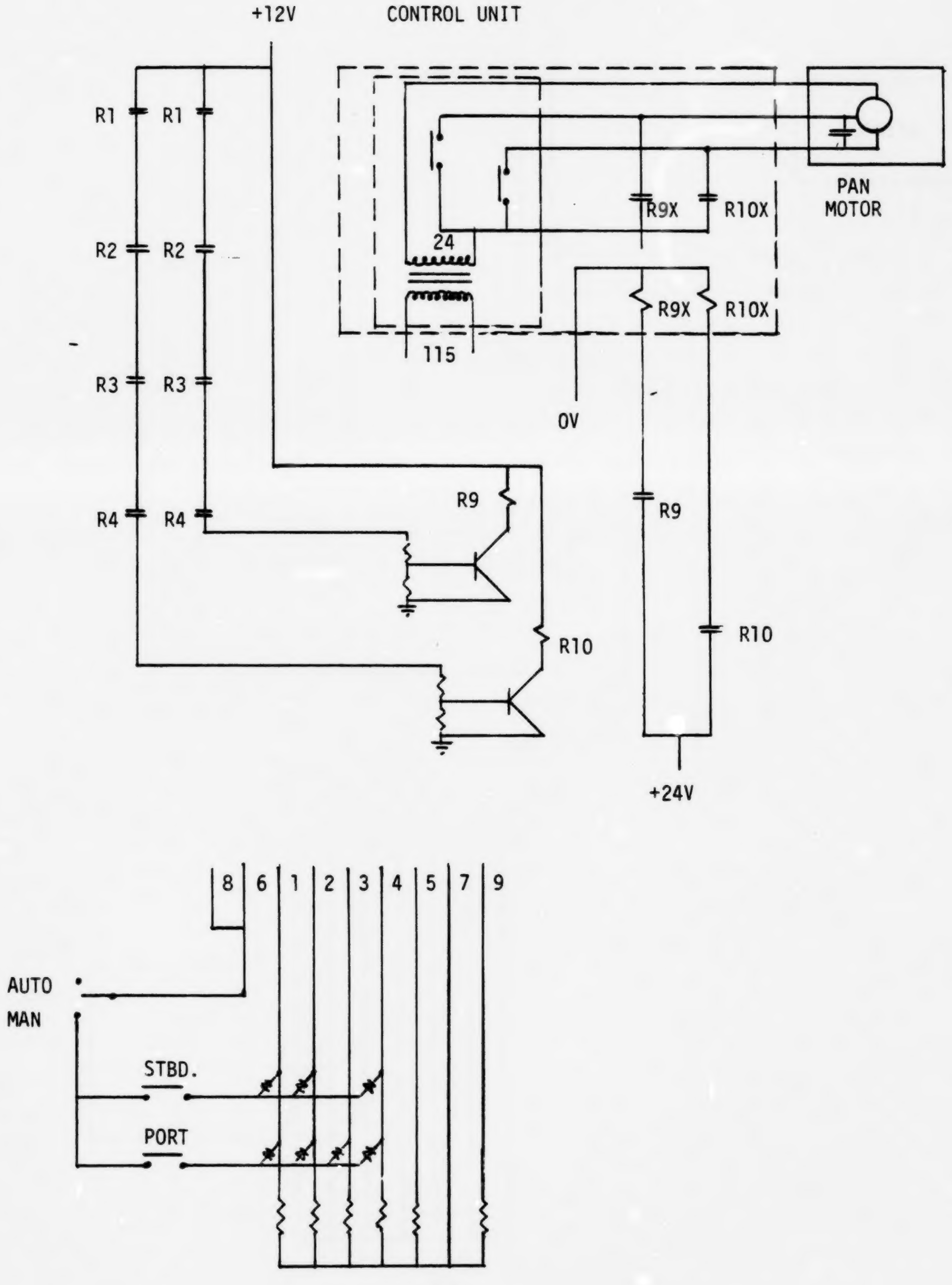
TABLE TV-1 CCTV Camera Control Logic

FIG. TV.2
CLOSED CIRCUIT T.V. SYSTEM: ZOOM CONTROL (SIMILAR FOR IRIS & FOCUS)


+24V
+12V
6
1
2
3
4
7
X001
X002
X003
X004
R1
R1
R2
R2
R3
R3
R4
R4
OUT
IN
R5
R2
+12V
0
-12V
ZOOM
MOTOR
OUT
IN
CONTROL
UNIT
8
6
1
2
3
4
5
7
9
AUTO
MAN
IN
OUT
TV7

## FIG. TV.3

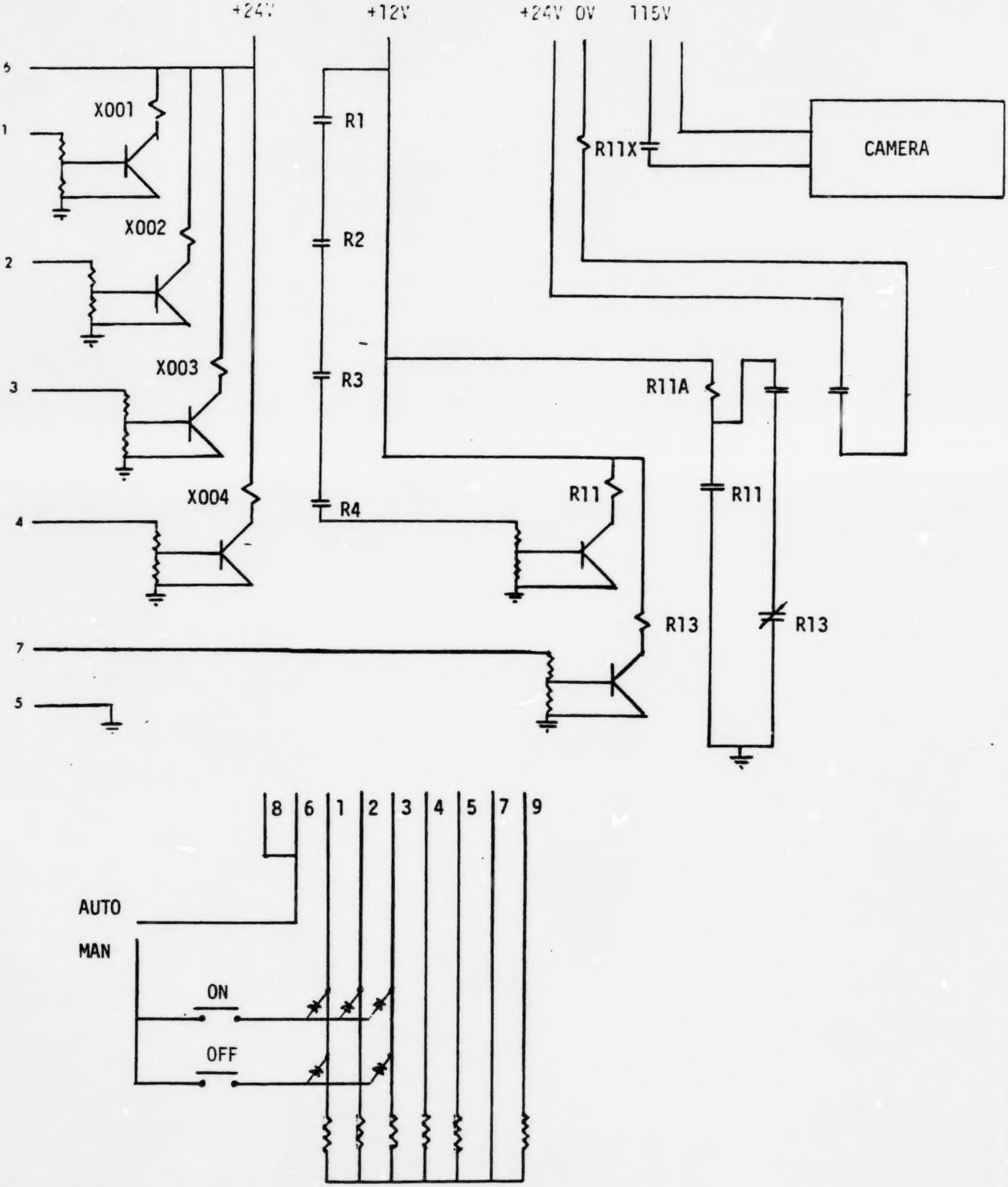
CLOSED CIRCUIT T.V. SYSTEM: PAN CONTROL (SIMILAR FOR TILT)



+12V
CONTROL UNIT
R1
R1
R2
R2
R3
R3
R4
R4
24
115
R9X
R10X
R9X
R10X
PAN
MOTOR
0V
R9
R9
R10
R10
+24V
8
6
1
2
3
4
5
7
9
AUTO
MAN
STBD.
PORT
TV8

## FIG. TV.4

CLOSED CIRCUIT T.V. SYSTEM: CAMERA POWER (SIMILAR FOR BLOWER POWER)


+24V
+12V
+24V
0V
115V
6
X001
1
R1
R11X
CAMERA
X002
2
R2
X003
3
R3
R11A
X004
R11
R11
4
R4
R13
R13
7
5
8
6
1
2
3
4
5
7
9
AUTO
MAN
ON
OFF

## 3. Wiring Diagrams

Fig. W1 - Schematic, Manual Control, CCTV System
Fig. W2 - Schematic, Command Coding Card, CCTV System
Fig. W3 - Backplane Connections, CCTV Camera Control, CCTV System
Fig. W4 - Schematic, Decoding Relay Card, Camera Control, CCTV System
Fig. W5 - Schematic, Relay Driver Card, Camera Control, CCTV System
Fig. W6 - Schematic, Slave Relay Card, Camera Control, CCTV System
Fig. W7 - Schematic, Power Relays, Camera Control, CCTV System
Fig. W8 - Camera Control Wiring Diagram (May 1980)
Fig. W9 - Closed Circuit Television System - General Arrangement
Fig. W10 - Command Coding Card

## WIRING DIAGRAMS: LABORATORY END

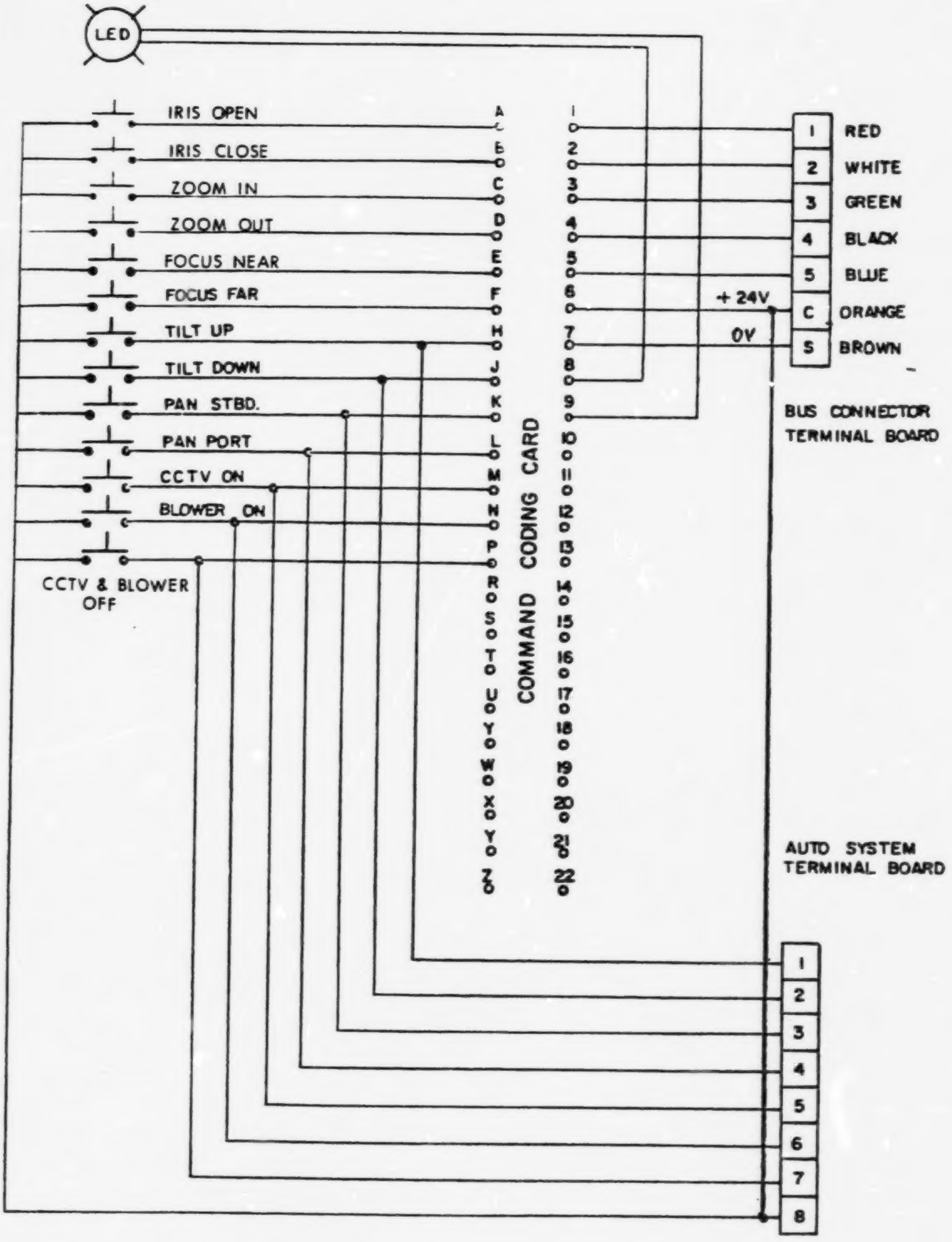

LED
IRIS OPEN
IRIS CLOSE
ZOOM IN
ZOOM OUT
FOCUS NEAR
FOCUS FAR
TILT UP
TILT DOWN
PAN STBD.
PAN PORT
CCTV ON
BLOWER ON
CCTV & BLOWER OFF
COMMAND CODING CARD
A B C D E F H J K L M N P R S T U V W X Y Z
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
+ 24V
0V
1 RED
2 WHITE
3 GREEN
4 BLACK
5 BLUE
C ORANGE
S BROWN
BUS CONNECTOR TERMINAL BOARD
AUTO SYSTEM TERMINAL BOARD
1
2
3
4
5
6
7
8

FIGURE W.1a SCHEMATIC, MANUAL CONTROL, C.C.T.V. SYSTEM

WIRING DIAGRAMS: LABORATORY END

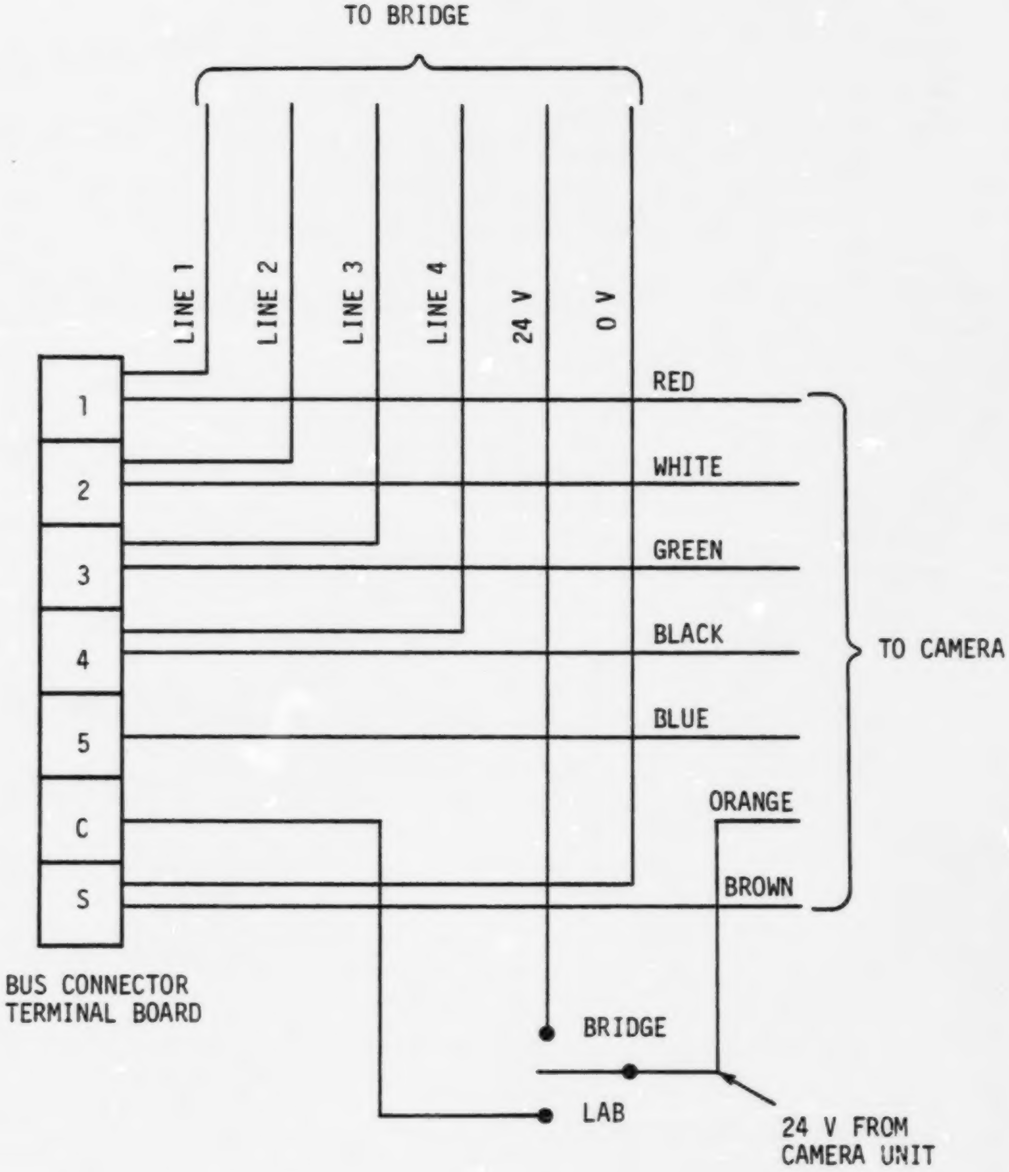

TO BRIDGE
LINE 1
LINE 2
LINE 3
LINE 4
24 V
0 V
1
2
3
4
5
C
S
RED
WHITE
GREEN
BLACK
BLUE
ORANGE
BROWN
TO CAMERA
BUS CONNECTOR
TERMINAL BOARD
BRIDGE
LAB
24 V FROM
CAMERA UNIT

FIGURE W.1b BUS CONNECTIONS, CCTV SYSTEM

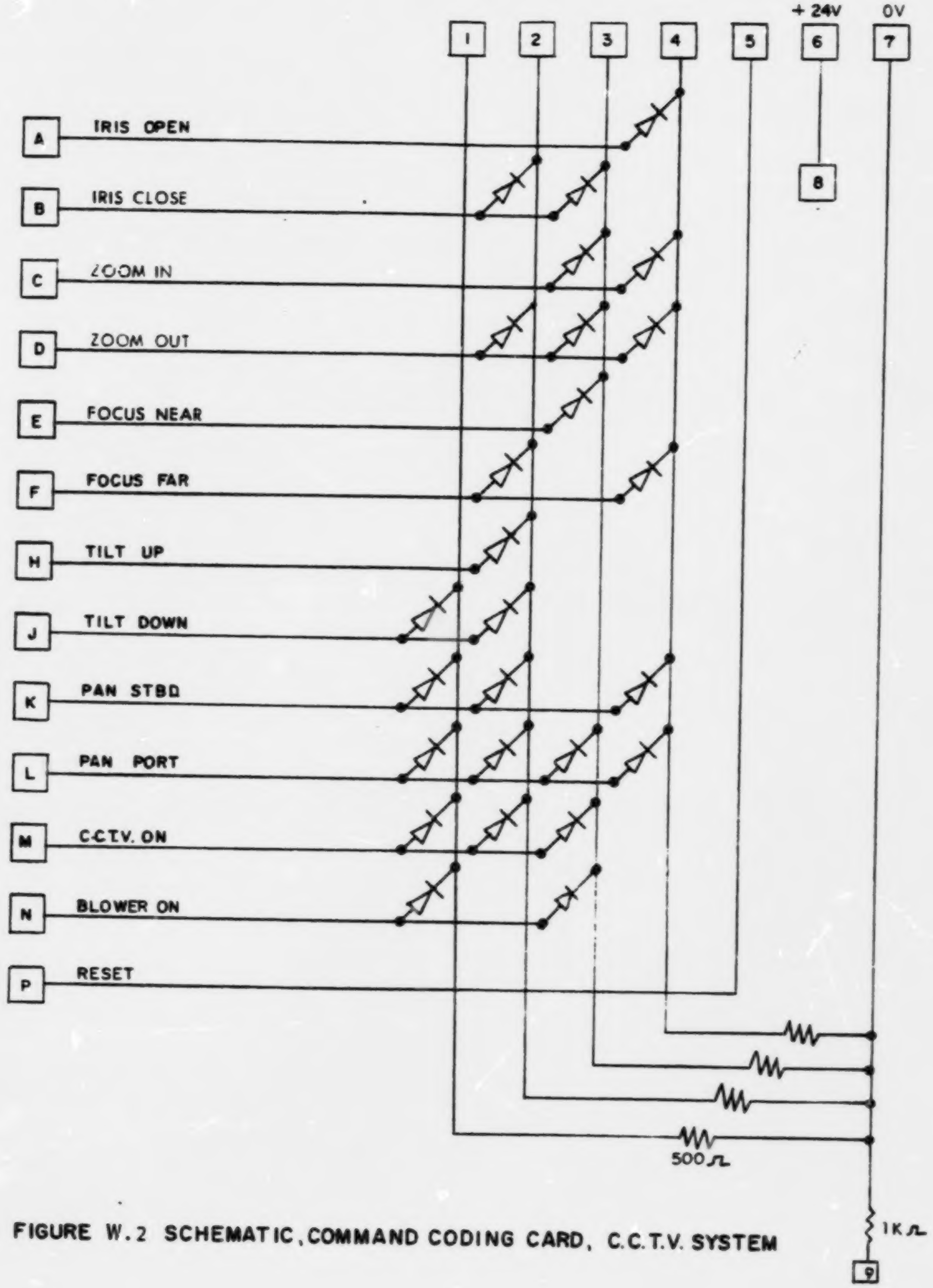

+ 24V
0V
1
2
3
4
5
6
7
8
A
IRIS OPEN
B
IRIS CLOSE
C
ZOOM IN
D
ZOOM OUT
E
FOCUS NEAR
F
FOCUS FAR
H
TILT UP
J
TILT DOWN
K
PAN STBD
L
PAN PORT
M
C.C.T.V. ON
N
BLOWER ON
P
RESET
500Ω
1KΩ
9

FIGURE W.2 SCHEMATIC, COMMAND CODING CARD, C.C.T.V. SYSTEM

WIRING DIAGRAMS: CAMERA END

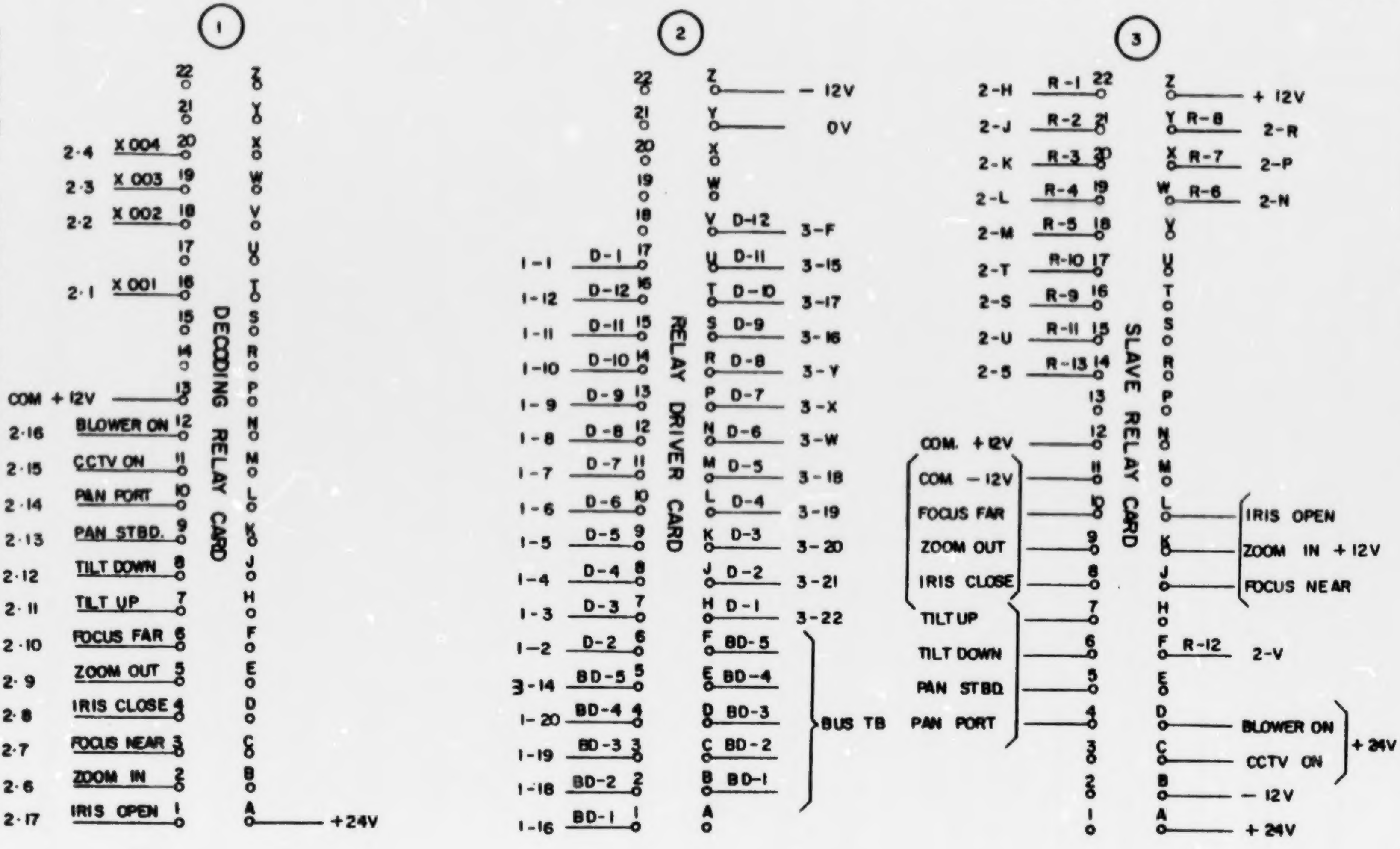

1
DECODING RELAY CARD
2·4 X 004 20
2·3 X 003 19
2·2 X 002 18
2·1 X 001 16
COM + 12V 13
2·16 BLOWER ON 12
2·15 CCTV ON 11
2·14 PAN PORT 10
2·13 PAN STBD. 9
2·12 TILT DOWN 8
2·11 TILT UP 7
2·10 FOCUS FAR 6
2·9 ZOOM OUT 5
2·8 IRIS CLOSE 4
2·7 FOCUS NEAR 3
2·6 ZOOM IN 2
2·17 IRIS OPEN 1
Z Y X W V U T S R P N M L K J H F E D C B A
A +24V
22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
2
RELAY DRIVER CARD
1-1 D-1 17
1-12 D-12 16
1-11 D-11 15
1-10 D-10 14
1-9 D-9 13
1-8 D-8 12
1-7 D-7 11
1-6 D-6 10
1-5 D-5 9
1-4 D-4 8
1-3 D-3 7
1-2 D-2 6
3-14 BD-5 5
1-20 BD-4 4
1-19 BD-3 3
1-18 BD-2 2
1-16 BD-1 1
Z — 12V
Y 0V
X
W
V D-12 3-F
U D-11 3-15
T D-10 3-17
S D-9 3-16
R D-8 3-Y
P D-7 3-X
N D-6 3-W
M D-5 3-18
L D-4 3-19
K D-3 3-20
J D-2 3-21
H D-1 3-22
F BD-5
E BD-4
D BD-3
C BD-2
B BD-1
A
BUS TB
3
SLAVE RELAY CARD
2-H R-1 22
2-J R-2 21
2-K R-3 20
2-L R-4 19
2-M R-5 18
2-T R-10 17
2-S R-9 16
2-U R-11 15
2-5 R-13 14
13
COM. +12V 12
COM −12V 11
FOCUS FAR 10
ZOOM OUT 9
IRIS CLOSE 8
TILT UP 7
TILT DOWN 6
PAN STBD. 5
PAN PORT 4
3 2 1
Z + 12V
Y R-8 2-R
X R-7 2-P
W R-6 2-N
V U T S R P N M
L IRIS OPEN
K ZOOM IN + 12V
J FOCUS NEAR
H
F R-12 2-V
E
D BLOWER ON
C CCTV ON
+ 24V
B — 12V
A + 24V

FIGURE W.3 BACKPLANE CONNECTIONS, C.C.T.V. CAMERA CONTROL, C.C.T.V. SYSTEM

8/1979

3501-606

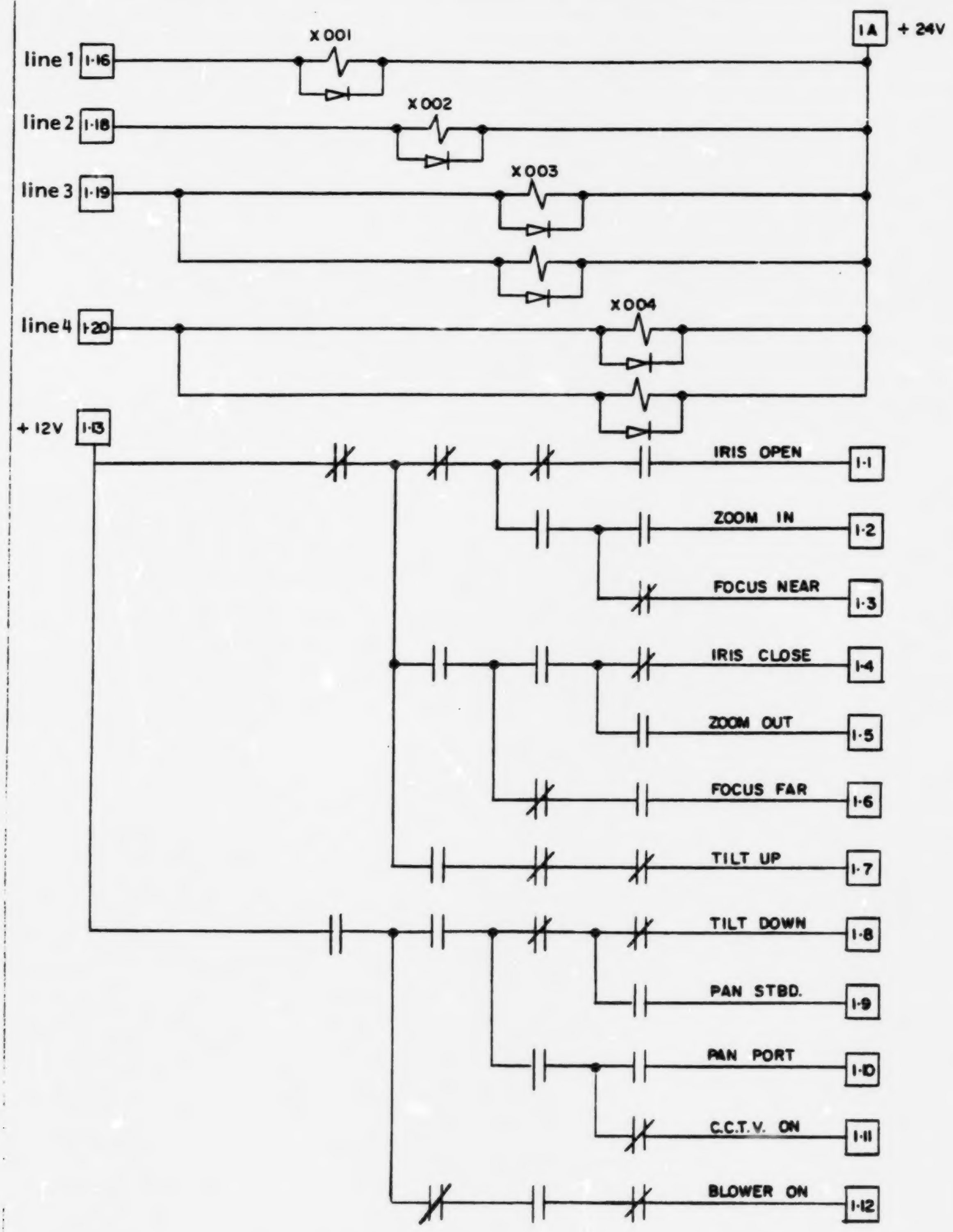
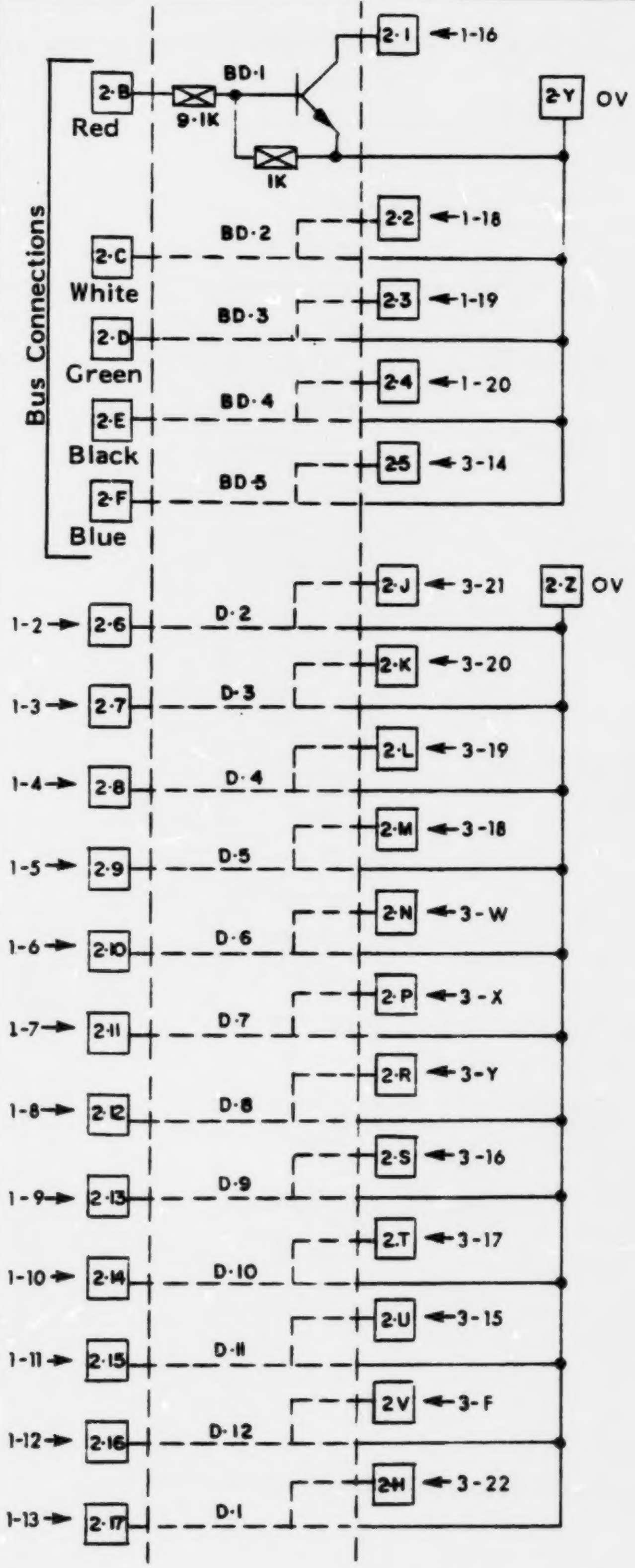

X001
X002
X003
X004
line 1
1·16
line 2
1·18
line 3
1·19
line4
1·20
1A
+ 24V
+ 12V
1·13
IRIS OPEN
1·1
ZOOM IN
1·2
FOCUS NEAR
1·3
IRIS CLOSE
1·4
ZOOM OUT
1·5
FOCUS FAR
1·6
TILT UP
1·7
TILT DOWN
1·8
PAN STBD.
1·9
PAN PORT
1·10
C.C.T.V. ON
1·11
BLOWER ON
1·12

FIGURE W.4 SCHEMATIC, DECODING RELAY CARD, CAMERA CONTROL, C.C.T.V. SYSTEM

CAMERA END


2·1 ← 1-16
2·B
Red
BD·1
9·1K
1K
2·Y OV
Bus Connections
2·2 ← 1-18
BD·2
2·C
White
2·3 ← 1-19
BD·3
2·D
Green
2·4 ← 1-20
BD·4
2·E
Black
2·5 ← 3-14
BD·5
2·F
Blue
2·J ← 3-21
2·Z OV
1-2 → 2·6
D·2
2·K ← 3-20
1-3 → 2·7
D·3
2·L ← 3-19
1-4 → 2·8
D·4
2·M ← 3-18
1-5 → 2·9
D·5
2·N ← 3-W
1-6 → 2·10
D·6
2·P ← 3-X
1-7 → 2·11
D·7
2·R ← 3-Y
1-8 → 2·12
D·8
2·S ← 3-16
1-9 → 2·13
D·9
2·T ← 3-17
1-10 → 2·14
D·10
2·U ← 3-15
1-11 → 2·15
D·11
2V ← 3-F
1-12 → 2·16
D·12
2H ← 3-22
1-13 → 2·17
D·1

ALL DRIVER CIRCUITS THE SAME

BD SERIES 24V

D SERIES 12V

FIGURE W.5 SCHEMATIC, RELAY DRIVER CARD, CAMERA CONTROL, C.C.T.V. SYSTEM

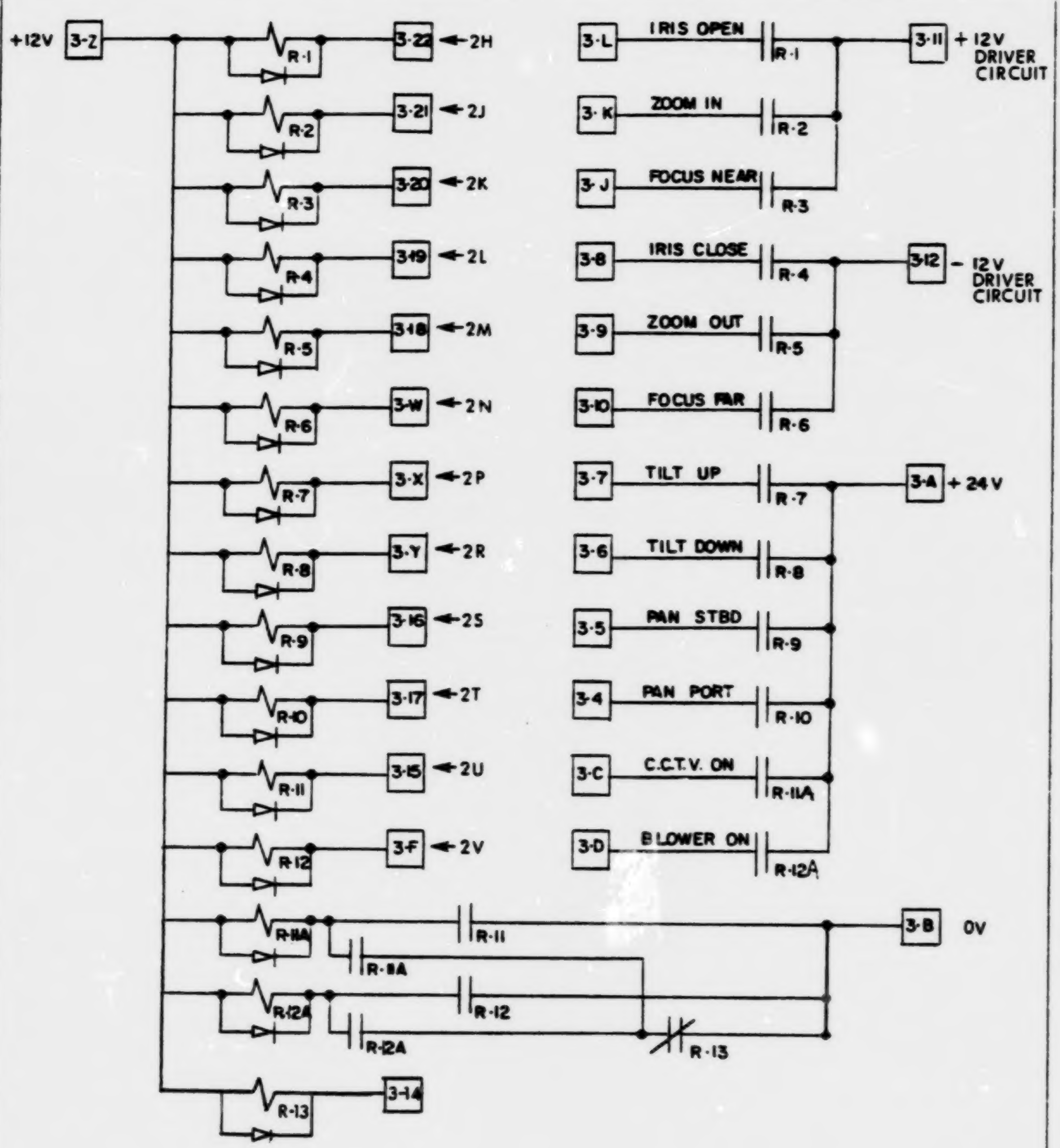
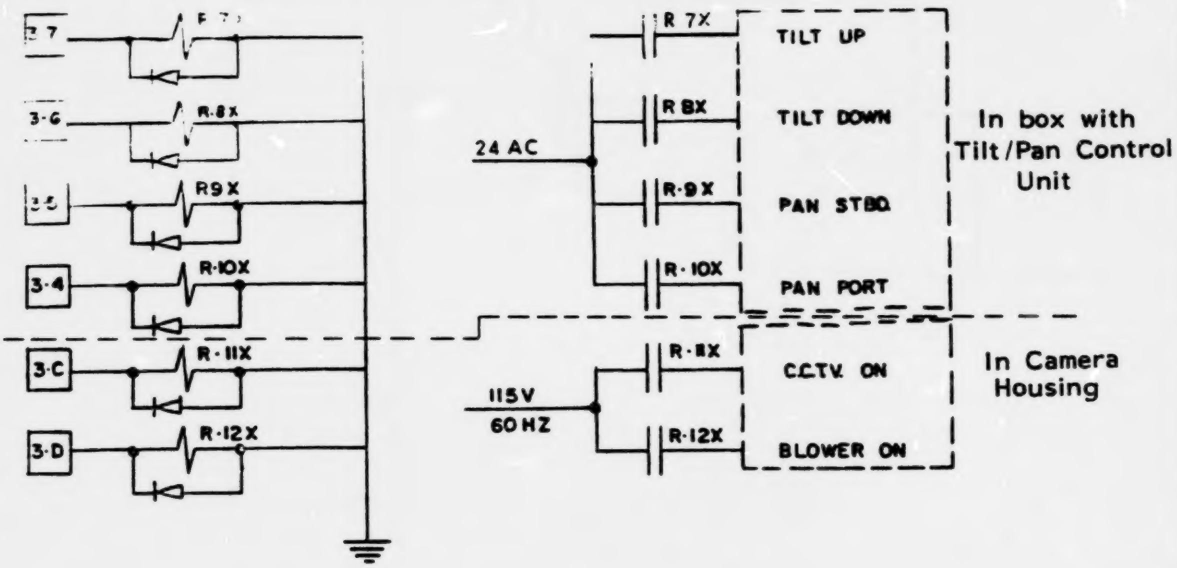

+12V
3-Z
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
R-11A
R-12A
R-13
3-22 ← 2H
3-21 ← 2J
3-20 ← 2K
3-19 ← 2L
3-18 ← 2M
3-W ← 2N
3-X ← 2P
3-Y ← 2R
3-16 ← 2S
3-17 ← 2T
3-15 ← 2U
3-F ← 2V
3-14
3-L IRIS OPEN R-1
3-K ZOOM IN R-2
3-J FOCUS NEAR R-3
3-8 IRIS CLOSE R-4
3-9 ZOOM OUT R-5
3-10 FOCUS FAR R-6
3-7 TILT UP R-7
3-6 TILT DOWN R-8
3-5 PAN STBD R-9
3-4 PAN PORT R-10
3-C C.C.T.V. ON R-11A
3-D BLOWER ON R-12A
3-11 + 12V DRIVER CIRCUIT
3-12 − 12V DRIVER CIRCUIT
3-A + 24V
3-B 0V
R-11
R-11A
R-12
R-12A
R-13

FIGURE W.6 SCHEMATIC, SLAVE RELAY CARD, CAMERA CONTROL, CCTV SYSTEM

CAMERA END

Relay commands come from logic decoders

Relay Contacts in with push buttons on control box


3·7
R 7X
3·6
R·8X
3·5
R9X
3·4
R·10X
3·C
R·11X
3·D
R·12X
24 AC
115V
60 HZ
R 7X
R 8X
R·9X
R·10X
R·11X
R·12X
TILT UP
TILT DOWN
PAN STBD.
PAN PORT
C.C.T.V. ON
BLOWER ON
In box with Tilt/Pan Control Unit
In Camera Housing

PAN & TILT CONTROLS

Camera Controls use 12V d.c. drive
Pan/Tilt Controls use 24V a.c. drive

FIGURE W.7 SCHEMATIC, POWER RELAYS, CAMERA CONTROL, C.C.T.V. SYSTEM

TV19

## CAMERA CONTROL WIRING DIAGRAM (MAY 1980)

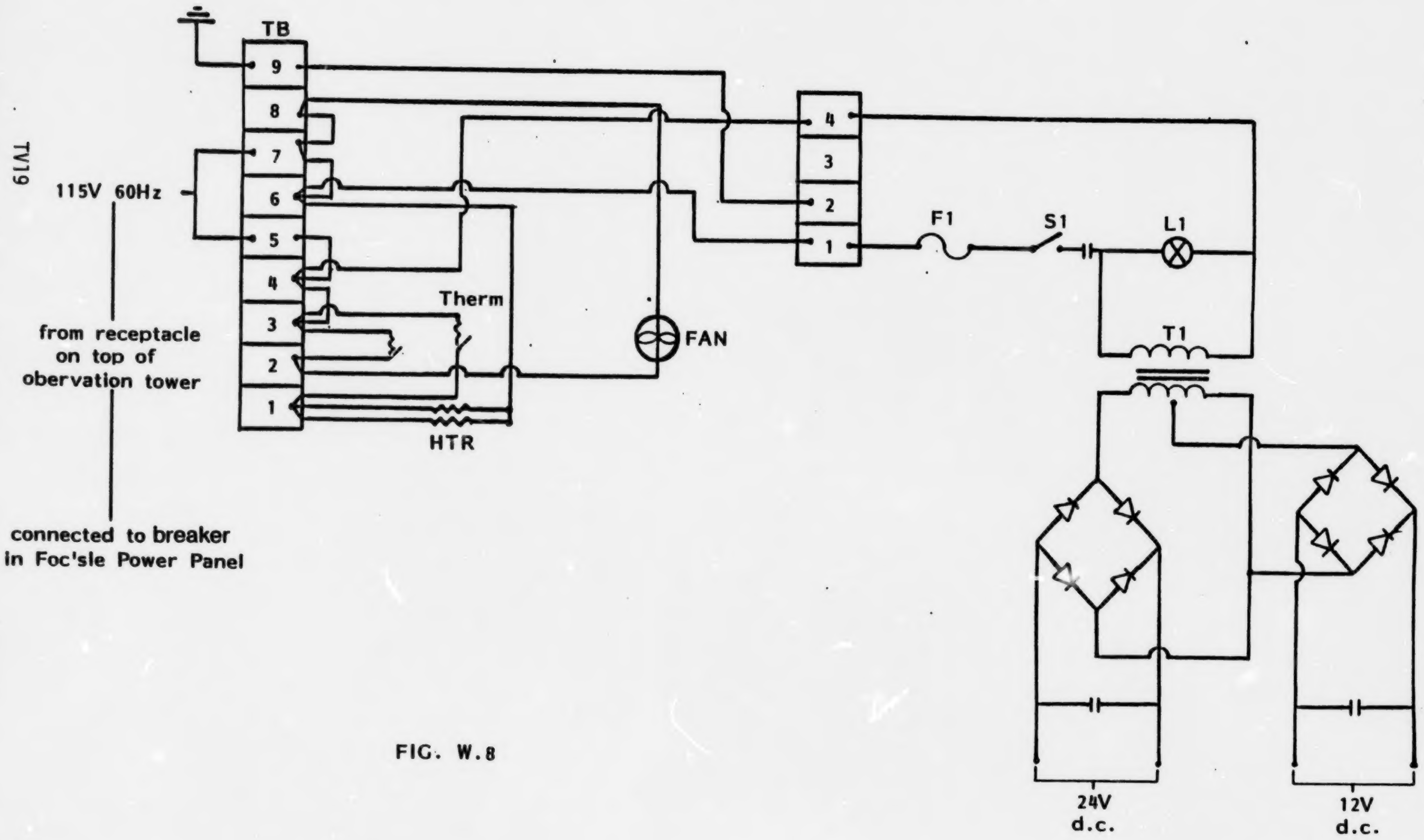
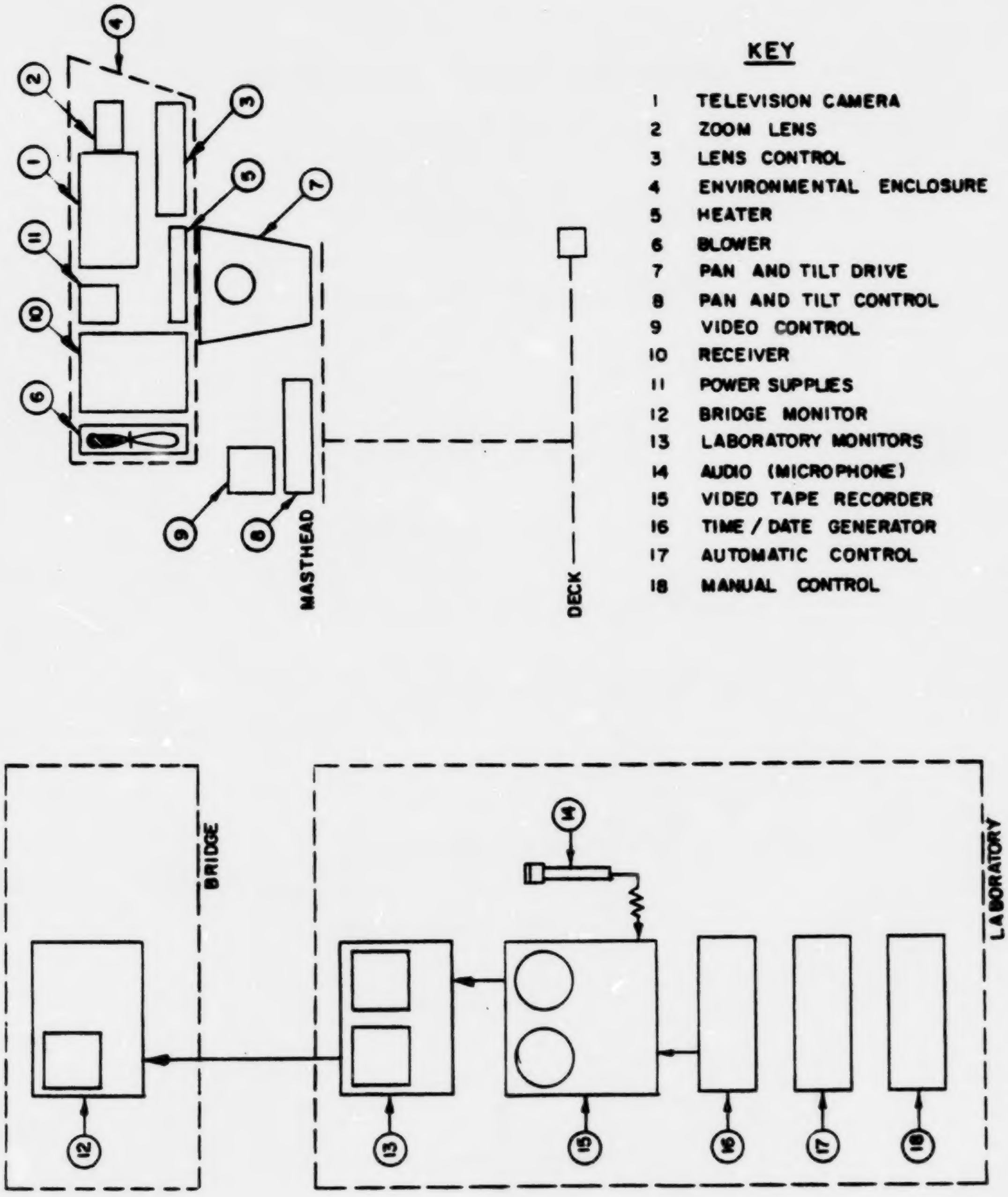

TB
9
8
7
6
5
4
3
2
1
115V 60Hz
from receptacle
on top of
obervation tower
connected to breaker
in Foc'sle Power Panel
Therm
HTR
FAN
4
3
2
1
F1
S1
L1
T1
24V
d.c.
12V
d.c.

FIG. W.8



4
2
3
1
5
7
11
10
6
9
8
MASTHEAD
DECK
BRIDGE
LABORATORY
14
12
13
15
16
17
18

**KEY**

1 TELEVISION CAMERA
2 ZOOM LENS
3 LENS CONTROL
4 ENVIRONMENTAL ENCLOSURE
5 HEATER
6 BLOWER
7 PAN AND TILT DRIVE
8 PAN AND TILT CONTROL
9 VIDEO CONTROL
10 RECEIVER
11 POWER SUPPLIES
12 BRIDGE MONITOR
13 LABORATORY MONITORS
14 AUDIO (MICROPHONE)
15 VIDEO TAPE RECORDER
16 TIME / DATE GENERATOR
17 AUTOMATIC CONTROL
18 MANUAL CONTROL

FIGURE W.9 CLOSED CIRCUIT TELEVISION SYSTEM – GENERAL ARRANGEMENT

## WIRING DIAGRAM: BRIDGE CCTV CONTROLS

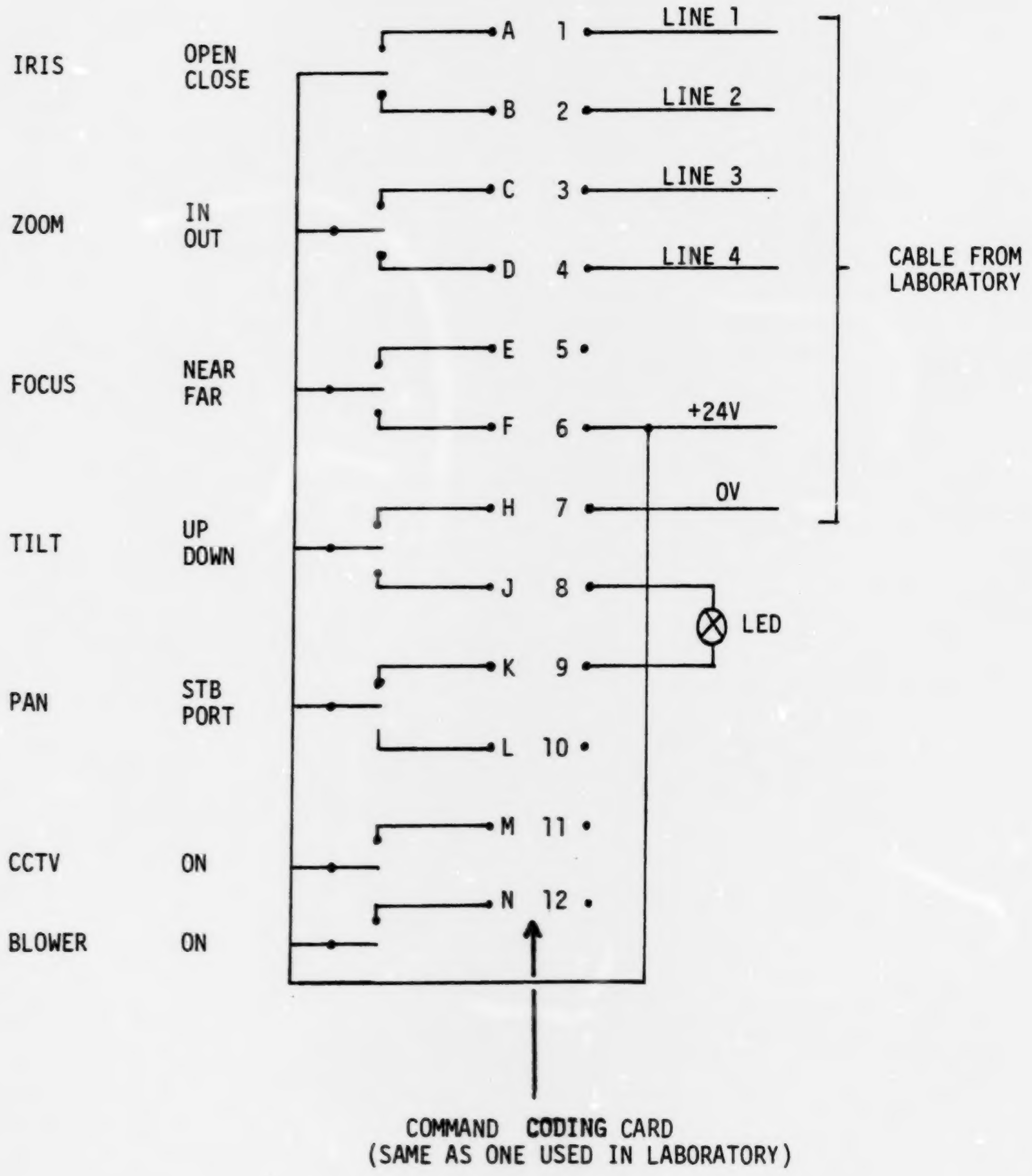

IRIS
OPEN
CLOSE
ZOOM
IN
OUT
FOCUS
NEAR
FAR
TILT
UP
DOWN
PAN
STB
PORT
CCTV
ON
BLOWER
ON
A
B
C
D
E
F
H
J
K
L
M
N
1
2
3
4
5
6
7
8
9
10
11
12
LINE 1
LINE 2
LINE 3
LINE 4
+24V
0V
LED
CABLE FROM
LABORATORY
COMMAND CODING CARD
(SAME AS ONE USED IN LABORATORY)

FIG. W.10

# PART IV

# MANUFACTURERS INFORMATION

## CONTENTS

Device — Page No.

Strain Gauge . . . . . . . . . . . . . . . . . . . . . . . . M1

Accelerometer . . . . . . . . . . . . . . . . . . . . . . . M2

Pressure Transducer . . . . . . . . . . . . . . . . . . . . M4

Propeller Thrust Measuring Device . . . . . . . . . . . . . M6

Torquemeter . . . . . . . . . . . . . . . . . . . . . . . . M11

Pressure Transducer . . . . . . . . . . . . . . . . . . . . M26

Computer System . . . . . . . . . . . . . . . . . . . . . . M32

Closed Circuit T.V. System . . . . . . . . . . . . . . . . M54

1.1

## SPECIFICATIONS

| MODEL NO. | STYLE | RESISTANCE | [1] GAGE FACTOR NOMINAL | INSULATION RESISTANCE |
|---|---|---|---|---|
| SG 156 | 3 Conductor, Individual Leads | 350 ±10 | 2.0 ±3% | >100 Megohm |
| SG 159 | 3 Conductor, Shielded, Jacketed Cable | 350 ±10 | 2.0 ±3% | >100 Megohm |
| SG 186 | 3 Conductor, Individual Leads | 120 ±3.5 | 1.90 ±3% | >100 Megohm |
| SG 189 | 3 Conductor, Shielded, Jacketed Cable | 120 ±3.5 | 1.90 ±3% | >100 Megohm |
| CG 126 | 3 Conductor, Individual Leads | 120 ±3.5 | 2.0 ±3% | >100 Megohm |
| CG 129 | 3 Conductor, Shielded, Jacketed Cable | 120 ±3.5 | 2.0 ±3% | >100 Megohm |

[1] Gage Factor values determined and reported for each lot. Tolerance control from reported lot value.

### ELECTRICAL SPECIFICATIONS

**Excitation Current:** Rated value, up to 50 milliamps. Maximum value, 100 to 300 milliamps depending upon environmental temperature and test specimen material.

**Rated Strain Level:** ±20,000 microinches per inch.

**Fatigue Life:** Exceed $10^8$ cycles at ±1000 microinches per inch.

**Transverse Sensitivity:** Negligible (line weld between strain tube and mounting flange).

### ENVIRONMENTAL SPECIFICATIONS

**Compensated Temperature Range:**
Static and dynamic measurements: 0° to 180°F.
Humidity: 100% at 180°F, 100 psi at 80°F.

**Apparent Strain With Temperature:** These strain gages are factory adjusted to a specific unmounted terminal slope value within a tolerance of ±50 microinches/inch. When the unit is mounted on a material having a temperature coefficient of expansion of 6 or 9 ppm/°F, as specifically ordered, the unmounted terminal slope is 0 ±80 microinches/inch over the range of 0 to 180°F.

**Gage Factor Change With Temperature:** Gage factor varies inversely with temperature approximately 1% per 100°F over the compensated temperature range.

**Additional Environments:** The strain gages have been subjected to the following environments and levels without deterioration of performance:

**Linear Sinusoidal Vibration:** 35 g, 20 to 2000 cps

**Static Acceleration:** 50 g

**Shock:** 100 g half-sine, 7 millisec duration

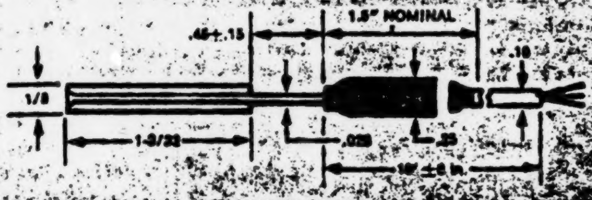
### MECHANICAL SPECIFICATIONS

**Strain Gage Configurations:** Reference dimensional outline drawings are shown below.

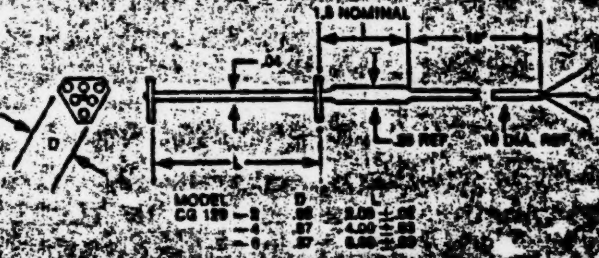
**Electrical Connections:** (Color Code)
Red — Active Black — Common White — Common

**Strain Gage Mounting Flange Material:** (for Weldable)
Stainless steel: AISI Type 321

**Test Specimen Materials:**
Weldable — intended for mounting on weldable ferrous and non-ferrous materials excluding aluminum and magnesium.
Embedment — intended for cementious materials.
Order weldable gage compensated for 6 or 9 ppm/°F material, embedment gage compensated for 6 ppm/°F.



MODEL SG 159



EMBEDMENT GAGE

# Specifications

## FLEXLEAD STRAIN GAGES — WELDABLE AND EMBEDMENT

**Entran Devices, Inc.**

# EGC-240 - D Series
# Damped Accelerometers

- 10g TO 200g RANGES
- 0.7 CRITICAL DAMPING
- 150 mV FULL SCALE

The EGC-240-D Damped accelerometer is the first miniature transducer of its kind. The EGC-D is a fluid damped accelerometer created for general testing where small transducers are required.

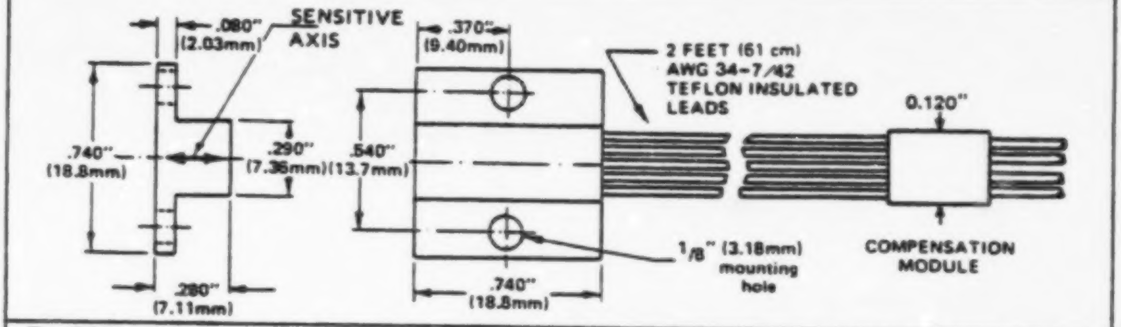
The EGC-D is nominally damped to 0.7 critical and designed to yield the flattest frequency response possible. While fluid damping eliminates ringing (excitation of the resonant frequency), thereby alleviating resonant noise problems, it also increases the handling capability of the transducer.

The EGC-D is standard in g ranges from 10 to 200 g with other ranges available on request. The EGC-D is a semiconductor strain gage accelerometer and operates in dynamic and steady state acceleration. Complete compensation is included with the accelerometer.

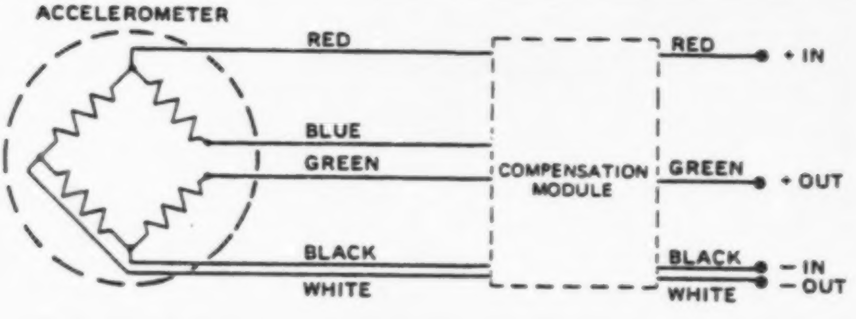
| | | |
|---|---|---|
| **Entran Devices, Inc.** | 145 Paterson Ave.<br>Little Falls, N. J. 07424<br>(201) 785-4060 | Pre-Bul. EGC240D-273 |

## SPECIFICATIONS

| MODEL | EGC-240-10D | EGC-240-20D | EGC-240-50D | EGC-240-100D | EGC-240-200D |
|---|---|---|---|---|---|
| RANGE | ± 10 g | ± 20 g | ± 50 g | ± 100 g | ± 200 g |
| OVER-RANGE | ± 30 g | ± 60 g | ± 150 g | ± 300 g | ± 600 g |
| SENSITIVITY mV/g (nom.) | 15 | 7.5 | 3 | 1.5 | .75 |
| UNDAMPED RES. FREQ. (nom.) | 700 Hz | 1000 Hz | 1500 Hz | 2300 Hz | 3000 Hz |
| FREQUENCY RESPONSE (±5%) | 200 Hz | 300 Hz | 450 Hz | 700 Hz | 1000 Hz |
| DAMPING (nom.) | 0.7 Cr. at 80°F | | | | |
| IMPEDANCE (nom.) | INPUT: 1000 ohms 2000 ohms optional OUTPUT: 500 ohms 1000 ohms optional | | | | |
| EXCITATION | 15 V DC or AC: For lower excitation voltages, specify at time of order. | | | | |
| NON-LINEARITY | ± 1 % F.S. | | | | |
| TRANSVERSE SENSITIVITY | 3 % (max.) | | | | |
| THERMAL ZERO SHIFT | ± 1% F.S./100°F | | | | |
| THERMAL SENSITIVITY SHIFT | ± 2.5%/100°F | | | | |
| COMPENSATED TEMP. RANGE | 80°F to 180°F (25°C to 80°C): Other compensation ranges available on request. | | | | |
| OPERATING TEMP. RANGE | −40°F to 250°F (−40°C to 121°C) | | | | |
| WEIGHT | 7 grams nom. (without leads) | | | | |


.080" (2.03mm)
SENSITIVE AXIS
.740" (18.8mm)
.290" (7.36mm)
.280" (7.11mm)
.370" (9.40mm)
.540" (13.7mm)
.740" (18.8mm)
2 FEET (61 cm) AWG 34-7/42 TEFLON INSULATED LEADS
1/8" (3.18mm) mounting hole
0.120"
COMPENSATION MODULE

The EGC's modular construction permits custom mounting for special requirements. Contact Entran for specific quotations. Thermal compensation module is located 18" from accelerometer housing. Internal compensation available on request.


ACCELEROMETER
RED
BLUE
GREEN
BLACK
WHITE
COMPENSATION MODULE
RED
+ IN
GREEN
+ OUT
BLACK
− IN
WHITE
− OUT

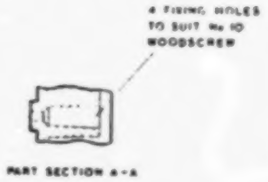
SE LABS (EMI) LTD.
NORTH FELTHAM TRADING ESTATE,
FELTHAM, MIDDLESEX.
Telephone: 890 5876

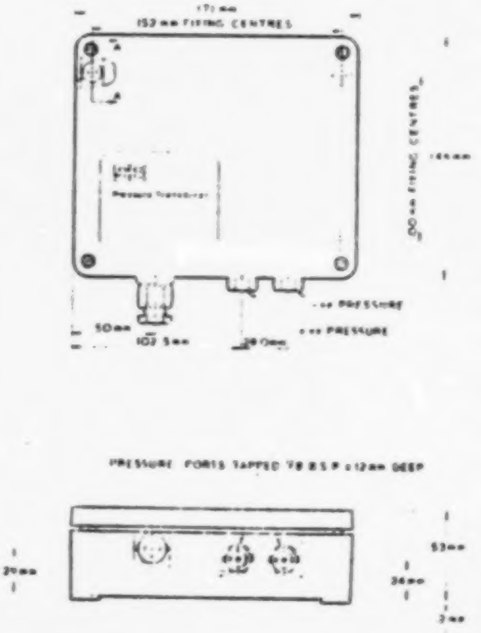
## PRESSURE TRANSDUCER RECORD SHEET

| | | | |
|---|---|---|---|
| TRANSDUCER TYPE No. | SE21/V/ 2000 psi D. | SERIAL No. | 17074 |
| CUSTOMER'S NAME | | W.O. No. | |
| DWG & ISS. No. | E42025 Iss. 2 | SPEC'N & ISS No. | SP440/3 |
| SUPPLY VOLTAGE | 24 ± 4V d.c. | SUPPLY CURRENT | 37mA NOM. |
| OUTPUT IMPEDANCE | < 1 Ω | NOISE | < 1mV r.m.s. |

## SUMMARY OF TESTS

| | | | |
|---|---|---|---|
| OUTPUT (VOLTS) | 1 VOLT d.c. | VOLTAGE LOAD (OHMS) | 1 K Ω |
| MAX. LINEARITY ERROR | < 0.1% | HYSTERESIS | < 0.1% |
| ZERO SHIFT WITH PRESS. REVERSAL | < N/A | CHANGE OF SLOPE PRESS. REVERSAL | < N/A |
| MAX. ERROR OVER TEMPERATURE RANGE -10°C to + 80°C | | < 1.2 | % |
| CHANGE IN OUTPUT FOR ± 4 VOLT SUPPLY VARIATION | | < 0.1 | % |
| INSULATION RESISTANCE AT 250 VOLTS D.C. | | > 100 | Meg. Ohms. |


4 FIXING HOLES TO SUIT No 10 WOODSCREW
PART SECTION A-A


171 mm
152 mm FIXING CENTRES
A
A
Pressure Transducer
100 mm FIXING CENTRES
50 mm
102.5 mm
38.0 mm
-ve PRESSURE
+ve PRESSURE
PRESSURE PORTS TAPPED 1/8 B.S.P. x 12mm DEEP
29 mm
53 mm
24 mm
3 mm

| Terminal | Connect To |
|---|---|
| +Supply | Power Supply +24V ±4V |
| –Supply | Power Supply '0'V |
| Output Hi | Measuring Instrument Hi Terminal |
| Output Lo | Measuring Instrument Lo Terminal |
| Cage | Earth at some convenient point |

Power Supply 24 ± 4V Impedance Source including Cable must be < 10 Ω

NOTE

The Supply Input is isolated from the Output such that an Earthed Supply and an Earthed Measuring Instrument may be used without causing system problems.

SE LABS (EMI) LTD.
NORTH FELTHAM TRADING ESTATE,
FELTHAM, MIDDLESEX.
Telephone: 890 5876

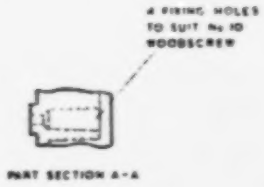
## PRESSURE TRANSDUCER RECORD SHEET

| | | | |
|---|---|---|---|
| TRANSDUCER TYPE No. | SE21/V 5000 PSI TD | SERIAL No. | 06408 |
| CUSTOMER'S NAME | | W.O. No. | |
| DWG & ISS. No. | E42025 ISS 2 | [illegible] | SP440/3 |
| SUPPLY VOLTAGE | 24 ± 4V d.c. | SUPPLY CURRENT | 37mA NOM. |
| OUTPUT IMPEDANCE | < 1 Ω | NOISE | < 1mV r.m.s. |

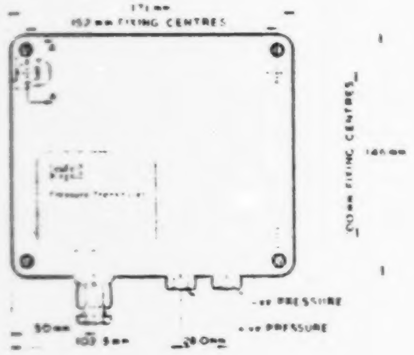
## SUMMARY OF TESTS

| | | | |
|---|---|---|---|
| OUTPUT (VOLTS) | 1 VOLT d.c. | VOLTAGE LOAD (OHMS) | 1 K Ω |
| MAX. LINEARITY ERROR | < 0.4% | HYSTERESIS | < 0.25% |
| ZERO SHIFT WITH PRESS. REVERSAL | < 0.18% | CHANGE OF SLOPE PRESS. REVERSAL | < 0.06% |

| | |
|---|---|
| MAX. ERROR OVER TEMPERATURE RANGE -10°C to + 80°C | < 1.06 % |
| CHANGE IN OUTPUT FOR ± 4 VOLT SUPPLY VARIATION | < 0.1 % |
| INSULATION RESISTANCE AT 250 VOLTS D.C. | > 100 Meg. Ohms. |

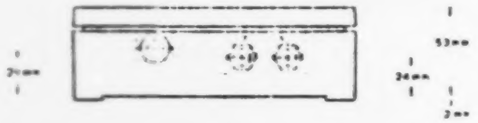

4 FIXING HOLES
TO SUIT No 10
WOODSCREW

PART SECTION A-A


171 mm
152 mm FIXING CENTRES
140 mm
120 mm FIXING CENTRES
-ve PRESSURE
+ve PRESSURE
50mm
103.5mm
20.0mm

| Terminal | Connect To |
|---|---|
| +Supply | Power Supply +24V ±4V |
| - Supply | Power Supply '0'V |
| Output Hi | Measuring Instrument Hi Terminal |
| Output Lo | Measuring Instrument Lo Terminal |
| Cage | Earth at some convenient point |

PRESSURE PORTS TAPPED 1/8 B.S.P x 12mm DEEP


53mm
29mm
24mm
2mm

Power Supply 24 ± 4V Impedance Source including Cable must be 10 Ω

NOTE

The Supply Input is isolated from the Output such that an Earthed Supply and an Earthed Measuring Instrument may be used without causing system problems.

M5

# RENK - CHECKER - RC 1 K3

## Propeller Thrust Measuring Device

For

Marine Reduction Gear Unit AUSL - 125

RENK ref. no. 640 612

## Short Description

Augsburg, 10-2-77

The RENK-CHECKER RC 1 K3 serves for monitoring the propeller thrust of the gear unit AUSL - 125. The monitoring is made in both thrust directions.

## 1. Electronic monitoring device

The electronic monitoring device is manufactured as a 19" plug-in package and is provided for installation in the control board at the engine stand.

The device has the following functions :

1.1 Digital display of the propeller thrust in both directions.

- The display has 4 figures
- The measuring time amounts to 1 s
- The thrust direction is indicated by a corresponding preceding sign "+" or "-".
- The calibration of the display is in Mp.

1.2 Voltage supply of the strain gauges placed on the load cells and corresponding processing (amplification) of the measuring signals.

1.3 Recorder outlet (i.e. UV recorder)

- Voltage outlet ± 10 V
- Max. current outlet ± 20 mA
- Signal adaptation to recorder by a potentiometer accessible from outside.

1.4 Calibration possibility for the recorder outlet

- Calibrating key for connecting the calibration value and disconnecting the signal.
- Calibration switch with 6 stages: 0,0.2, 0.4,0.6,0.8,1. Position 1 corresponds to a propeller thrust of 120 Mp.

## 2. Propeller thrust measuring points

2.1 The measurement of the thrust is made by means of load cells arranged between the round segments and the gear unit casing.

2.2 For manufacturing technical reasons, only 10 of the 12 round segments each of the ahead and astern side of the thrust bearing are equipped accordingly.

2.3 The load cells are equipped with strain gauges.

2.4 The connection of all load cells are lead out of the gear unit through a total of 4 built-in sockets.
(1 box each of the upper and bottom half of the thrust bearing and this for the ahead and astern sides).

2.5 The wiring of the strain gauges is made in distribution boxes mounted onto the gear unit.
(1 box each for the ahead and astern directions).

2.6 From one of both distribution boxes a common wire is leading to the electronic monitoring device.
(Connection 19 po. Socket A-20 A 48 PN VG 95 234).

## 3. Technical data

| | |
|---|---|
| Type : | RC 1 K3 |

Connecting values

| | |
|---|---|
| Connecting voltage | 220 V ± 15 % |
| Mains frequency | 50 - 100 Hz |
| Power absorption | abt. 150 VA |

Mechanical Data

Electronic monitoring device

| | |
|---|---|
| Dimensions: | 19" plug-in<br>Height 129 mm<br>Depth 410 mm |
| Weight: | Abt. 6.5 kp |

(For transport, the device is built-in into a box of 19")

## 4. Scope of Supply

1 Electronic monitoring device

1 Mains cable

1 Connecting socket for the recorder outlet

1 Connecting cable - Length m.

(for connecting the electronic monitoring device to the measuring system)

1 Measuring system fixed in or on the gear unit.

# SHAFT TORQUEMETER AND TELEMETRY

Manufacturer: German and Milne Inc.
1010, Ste-Catherine Street West
Suite 601
Montreal, Quebec H3B 1G2

# SHAFT TORQUEMETER AND TELEMETRY

## Introduction

The shaft telemetry system amplifies signals from two sets of strain gauges fitted to the propeller shaft and transmits them to a stationary unit for connection into the data logging system at Box No. 6

There are two parts:

### 1. Base Circuits

This unit is located above the propeller shaft, on the starboard side and forward of the propeller pitch oil distribution block. Power is transmitted to the shaft by a 100 KHz low frequency RF signal connected through a capacitive coupling. There is no physical contact with the shaft. Strain signals received from the shaft are converted to D.C. voltages and connected to the data logger.

### 2. Shaft Circuits

This unit is located on the propeller shaft forward of the propeller pitch oil distribution block. RF power from the base circuits is rectified and regulated to provide a stable source for the strain gauge and signal transmission circuits. The two strain gauge bridges are supplied by an A.C. source, the signals amplified and transmitted back to the base circuits by 27 MHz carriers having 5 KHz FM subcarriers.

## Circuit Descriptions

### 1. Base Circuits

115 VAC 60 Hz power is connected through a fuse and switch to a 24 volt centre tapped transformer. This is converted into plus and minus 15 vdc by a rectifier capacitor combination. It is also regulated by a 3501-1-01 regulator card to produce plus and minus 7.5 vdc for the critical circuits.

A 100 KHz oscillator and amplifier, 3501-403, provides a 400 vac radio signal for connection to the shaft coupling plates. A 27 MHz radio receiver, 3501-404 card, operates from the same connection to provide two telemetry channels. The 100 KHz and 27 MHz radio frequencies are combined in the shaft coupling card 3501-406 so that neither one appreciably affects the circuits of the other. The two FM subcarrier outputs from the receiver are digitally demodulated in a conventional but precision demodulator and filtered for connection to the data logger circuits. This circuitry is located on the 3501-406 card.

### 2. Shaft Circuits

The 100 KHz power from the shaft coupling ring is connected through a diplexer to separate 100 KHz power and 27 MHz telemetry signals. This

## Circuit Descriptions (Cont'd)

### 2. Shaft Circuits (Cont'd)

takes place in the 3501-1-05 card which has also a 100 KHz transformer, rectifier and smoothing capacitors to produce plus and minus 10 vdc power supplies. These raw supplies are regulated by a 3501-402 card to provide plus and minus 7.5 vdc supplies.

The AC supply for the strain gauge bridges is generated by a 3501-407 card, which also generates timing signals for synchronous demodulation in the amplifier cards. Current defining resistors for the strain gauges and amplification are taken care of by the 3501-408 card and the DC strain signals converted into an FM subcarrier by the 3501-407 card. The subcarrier then modulates two transmitter channels located on the 3501-406 card from whence the signal is coupled back to the base circuit receivers.

## Parts List

### 1. Base Circuits

a) Equipment box having:

- i) power cord and plug for connection to 115 VAC source
- ii) two 5-pin connectors to carry the two signal channels to the data logger
- iii) a high voltage cable to carry the 100 KHz and 27 MHz signals to and from the shaft coupling plates

The equipment box contains:

- i) a terminal strip with connections for the 115 VAC mains and output signals
- ii) an electronic equipment chassis with:
  - (a) regulated power supply containing power transformer, rectifiers, smoothing capacitors and regulator card
  - (b) a 100 KHz supply card
  - (c) a 27 MHz receiver card
  - (d) a shaft coupling circuit card

b) Two shaft coupling plates

Parts List (Cont'd)

2. Shaft Circuits

a) Shaft coupling and mounting ring assembly. This contains:

- i) coupling ring mounting assembly
- ii) coupling ring
- iii) electronic equipment chassis with:
  - One 27 MHz transmitter card in which a diplexer and power supply are employed
  - One 27 MHz transmitter card in which the diplexer and power supply are not employed
  - One regulator card
  - One bridge supply card
  - One dual amplifier card
- iv) two full bridge strain gauge assemblies
- v) one terminal strip carrying the strain gauge connections and accessible for calibration

Specifications

1. Strain gauge terminating and amplifying circuits.

(a) Bridge supppy current: 28.33 mA

(b) Bridge supply current stability: ± 0.5% over the temperature range 0 to 40° C

(c) Bridge supply frequency: 10 KHz ± 1%

(d) Bridge supply frequency stability: ± 1% max. over the frequency range 0 to +40°

(e) Amplifier gain: 1000 ± 1.0%

(f) Amplifier gain stability: ±0.5% max. over the temperature range of 0 to +40° C

(g) Amplifier output D.C. voltage drift: ±25 mV max. over the temperature range 0 to +40° C

(h) Amplifier output range for linear operation: ± 5.0 Vdc

Note: This corresponds to a change in strain of 1000 microstrain assuming a gauge factor of 2.0

## Specifications (Cont'd)

2. Telemetry Circuits

   (a) FM subcarrier frequency 5.0 KHz

   (b) Frequency range for ±5.0 Vdc input: 1.40 to 8.60

   (c) Frequency stability: ± 0.3% over the temperature range 0 to +40°C

   (d) Carrier frequencies: Channel 1: 27.475 MHz
   Channel 2: 27.515 MHz

   (e) Transmitted power: 10 mW per channel, nominal

   (f) Receiver sensitivity: 1.0 mV per channel nominal

   (g) Receiver AGC range: 1.0 mV to 0.5V per channel

   (h) Discriminator output voltage range ±5 Vdc for subcarrier frequency range 1.40 to 8.60 KHz

   (i) Discriminator adjustment: potentiometer control to accept centre frequencies in the range 4.0 to 7.5 KHz

   (j) Discriminator output voltage drift: ± 25 mV maximum over the temperature range 0 to +40°C

Overall performance specification: these tolerances add up to produce a stability over the temperature range of better than ±2.8% of full scale.

## Calibration

In any telemetry system such as this, there are multiple sources of error, these are best minimised by an overall calibration. This is done by bridging the strain gauge connections at a terminal strip mounted to the shaft coupling ring mounting assembly facing the gear box (due to an unbalance in the shaft system, this terminal strip comes to the top when the clutch is disengaged and is easily accessible). Calibration is a matter of bridging the strain gauge bridges with various resistors and measuring the discriminator output voltage after buffering by the appropriate channel card in the data logging equipment Junction Box No. 6.

The voltages should be as follows:

Output Voltage with Calibrating Resistor Connectors

| Resistor Value | Across RH Side of Bridge | Across LH Side of Bridge |
|---|---|---|
| None | + 5.0 V | + 5.0 V |
| 120,000 ohms | + 6.25 V | + 3.75 V |
| 60,000 ohms | + 7.5 V | + 2.5 V |
| 30,000 ohms | + 10.0 V | + 0.0 V |

## Adjustments:

Gain adjustments should be made on the interface card in Junction Box No. 6

The range adjustment in the base circuits, shaft coupling card (3501-406) should be made with the shaft stationary and gears disengaged, to provide 0 Vdc at the discriminator outputs pins 7 and 13.

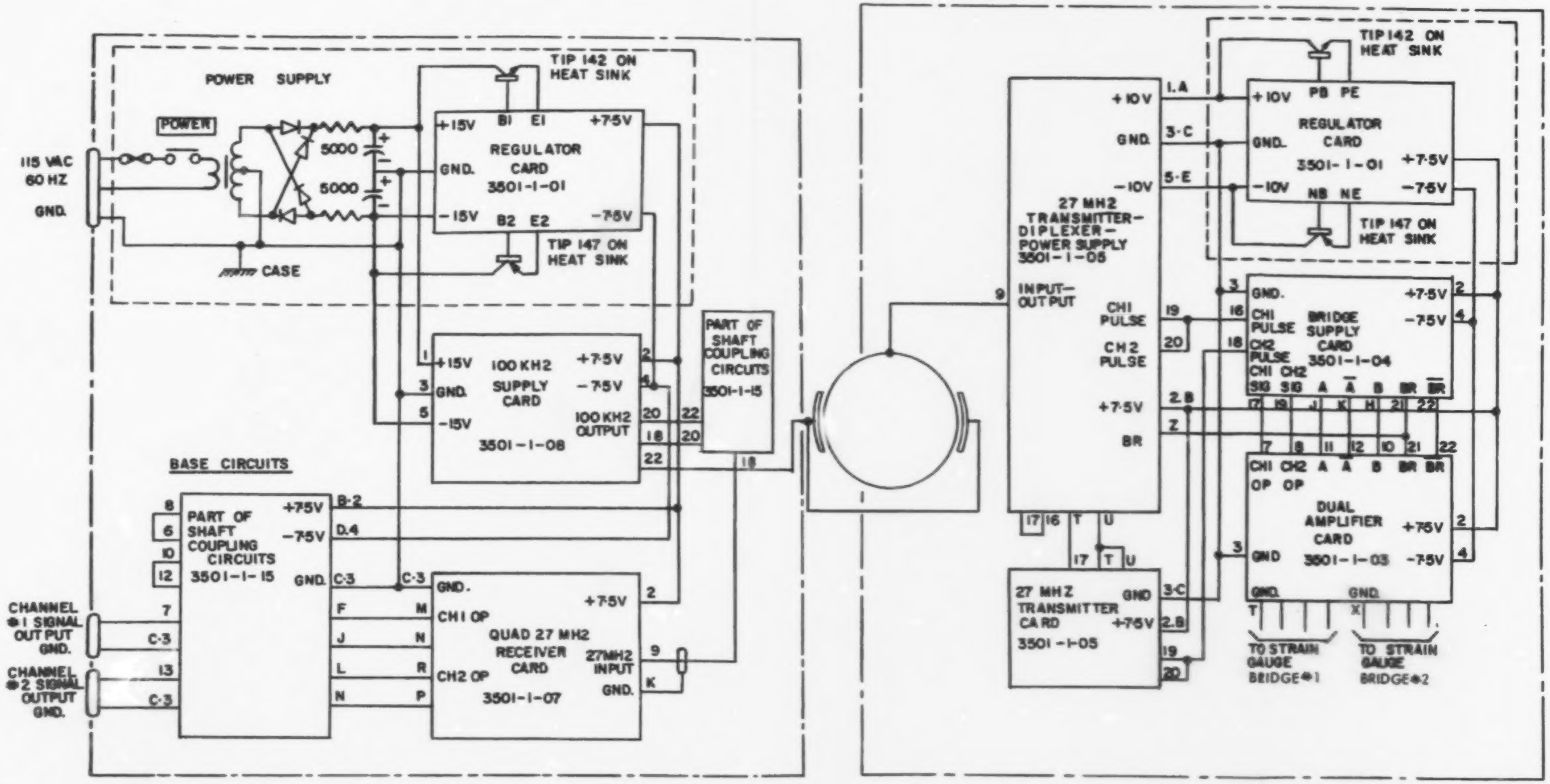
The strain gauge bridge offset can be adjusted. Fine and coarse controls are provided for each of the two channels on the dual amplifier card (3501-408) located on the abaft electronic equipment chassis. This is accessible when the coupling ring is removed. Power is connected to the shaft circuits by connecting a 150 pF 1000 V capacitor between one of the coupling plates and the circuit connection to the coupling ring. The amplifier outputs are accessible on pins 7 and 8. There are no other adjustments.

## Power Coupling Check:

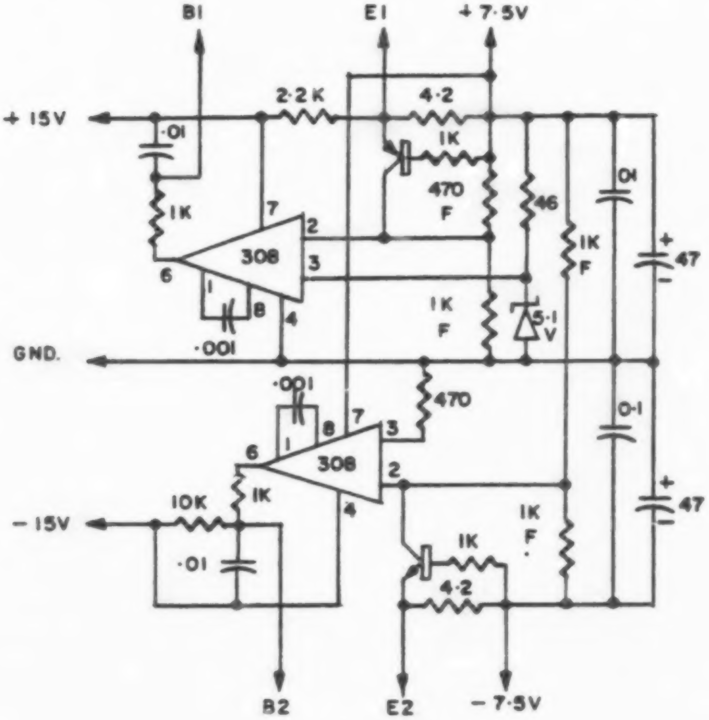
The system will only work within the tolerances when sufficient power is being coupled across to the shaft coupling ring. The regulated + and - 7.5 V supplies derived from the 100 KHz power input are brought out to the terminal strip on the coupling ring mounting assembly. These are the three wires at the centre of the strip. Red: +7.5V; Black: ground; White: -7.5 V. These are easily accessible in all positions of the shaft and can be checked with the shaft turning gear in operation.

## Signal Polarity:

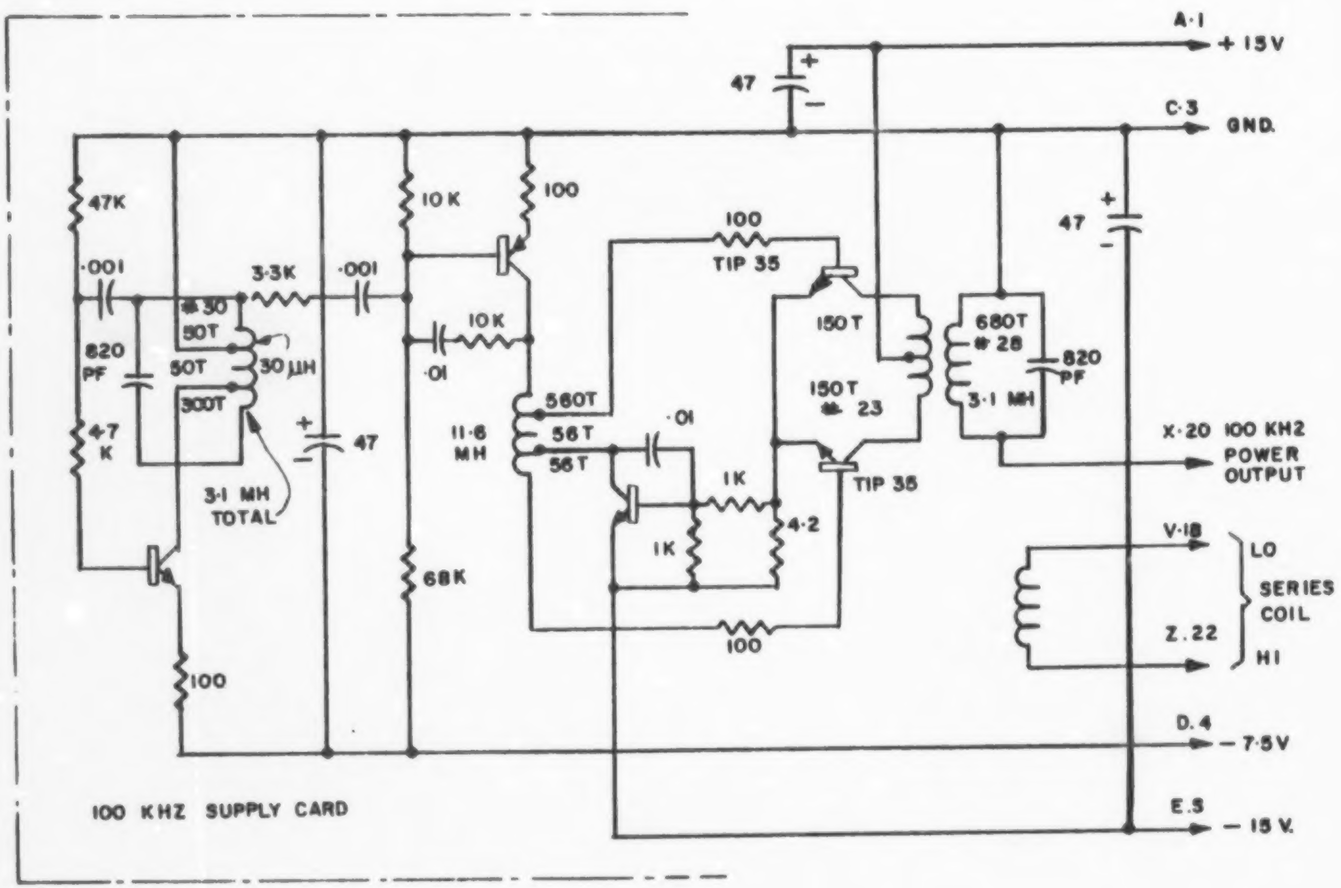
The strain gauges have been mounted, possibly by accident so that one channel has a positive output for increasing torque and the other negative. This can be remedied if required by swapping two of the leads on the negative channel strain gauge connections.


POWER SUPPLY
POWER
115 VAC 60 HZ
GND.
5000
5000
CASE
TIP 142 ON HEAT SINK
TIP 147 ON HEAT SINK
+15V B1 E1 +7.5V
REGULATOR CARD 3501-1-01
GND.
-15V B2 E2 -7.5V
+15V 100 KHZ SUPPLY CARD 3501-1-08
GND.
-15V
+7.5V
-7.5V
100 KHZ OUTPUT
PART OF SHAFT COUPLING CIRCUITS 3501-1-15
BASE CIRCUITS
PART OF SHAFT COUPLING CIRCUITS 3501-1-15
+7.5V B-2
-7.5V D.4
GND. C-3
CHANNEL #1 SIGNAL OUTPUT GND.
CHANNEL #2 SIGNAL OUTPUT GND.
GND.
CH1 OP
CH2 OP
QUAD 27 MHZ RECEIVER CARD 3501-1-07
+7.5V
27MHZ INPUT
GND.
27 MHZ TRANSMITTER-DIPLEXER-POWER SUPPLY 3501-1-06
+10V
GND.
-10V
INPUT-OUTPUT
CH1 PULSE
CH2 PULSE
+7.5V
BR
1.A
3-C
5-E
2.B
Z
+10V PB PE
REGULATOR CARD 3501-1-01
GND.
-10V NB NE
+7.5V
-7.5V
TIP 142 ON HEAT SINK
TIP 147 ON HEAT SINK
GND.
CH1 PULSE
CH2 PULSE
BRIDGE SUPPLY CARD 3501-1-04
CH1 SIG CH2 SIG A Ā B BR B̄R̄
+7.5V
-7.5V
CH1 OP CH2 OP A Ā B BR B̄R̄
DUAL AMPLIFIER CARD 3501-1-03
GND
+7.5V
-7.5V
GND. GND.
27 MHZ TRANSMITTER CARD 3501-1-05
GND
+7.5V
TO STRAIN GAUGE BRIDGE #1
TO STRAIN GAUGE BRIDGE #2

WIRING DIAGRAM, TORQUEMETER


B1
E1
+ 7·5V
+ 15V
·01
2·2K
4·2
1K
470
F
46
01
1K
F
+
47
308
7
2
3
6
1
8
4
·001
1K
F
5·1
V
GND.
·001
470
0·1
308
8
7
3
6
1
2
4
1K
10K
– 15V
·01
1K
F
1K
4·2
+
47
B2
E2
– 7·5V

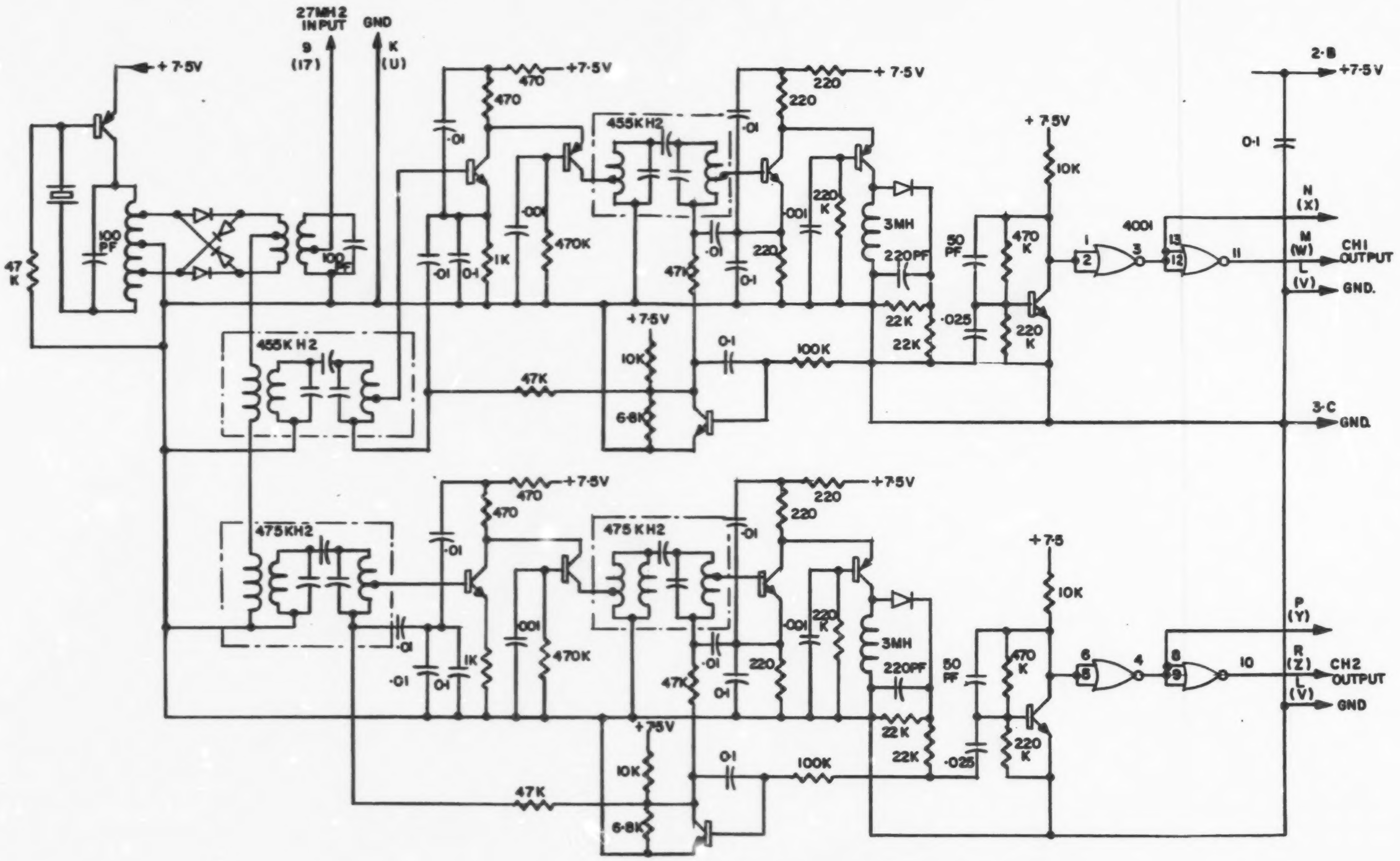
LOGIC DIAGRAM, REGULATOR CARD (TORQUEMETER)


A·1
+ 15 V
C·3
GND.
47
47K
·001
3·3K
·001
10 K
100
100
TIP 35
150 T
150 T
# 23
TIP 35
680T
# 28
3·1 MH
820
PF
47
#30
50T
50T
300T
30 µH
820
PF
4·7
K
3·1 MH
TOTAL
47
·01
10 K
11·6
MH
560T
56T
56T
·01
1K
1K
4·2
68K
100
100
X·20
100 KH2
POWER
OUTPUT
V·18
LO
SERIES
COIL
Z.22
HI
D.4
− 7·5V
E.5
− 15 V.
100 KHZ SUPPLY CARD

LOGIC DIAGRAM, 100 KHZ SUPPLY CARD ( TORQUEMETER)

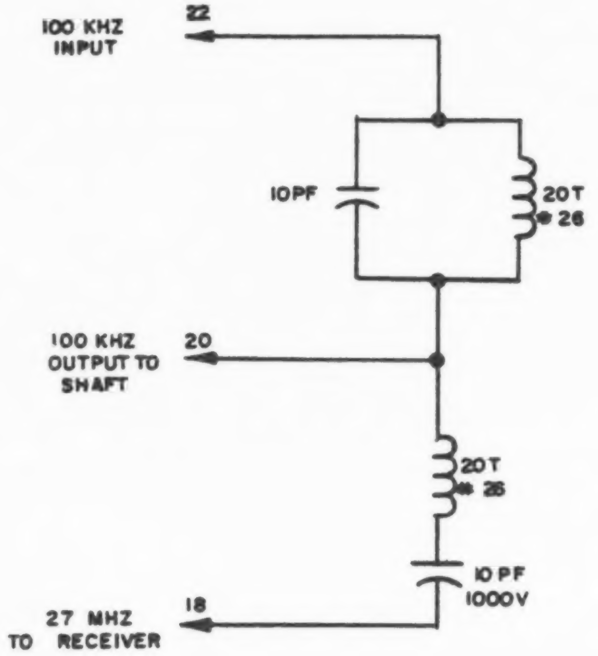
8/1979

3501-403

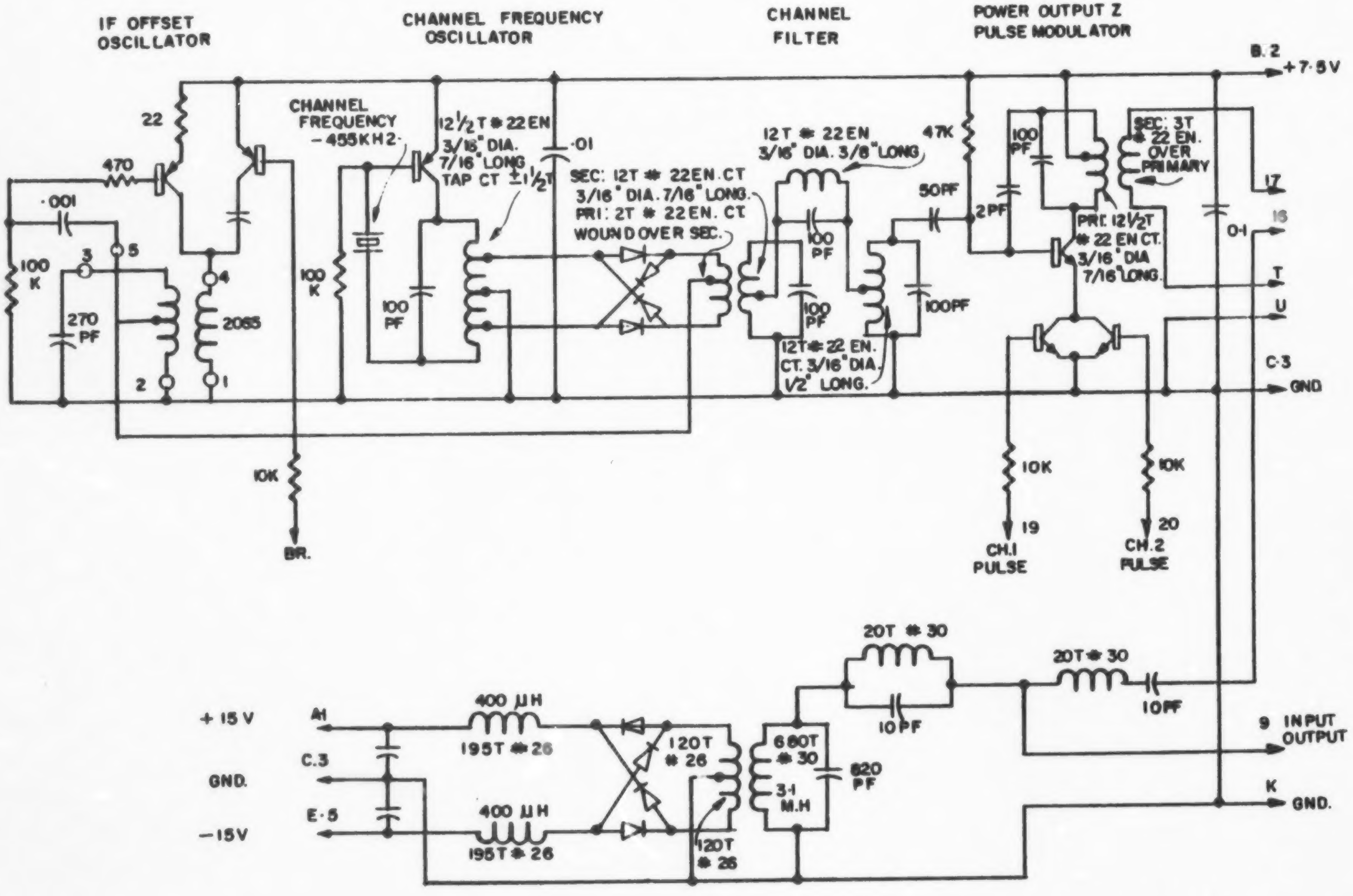

27MHZ INPUT
9
(17)
GND
K
(U)
+7.5V
47K
100 PF
100 PF
455KHZ
475KHZ
470
.01
.001
470K
1K
.01
0.1
220
3MH
220PF
50 PF
470K
220K
22K
.025
10K
6.8K
47K
0.1
100K
4001
1
2
3
13
12
11
6
5
4
8
9
10
2-B
0-1
N (X)
M (W)
L (V)
CH1 OUTPUT
GND.
3-C
GND.
P (Y)
R (Z)
CH2 OUTPUT
GND

TWO IDENTICAL CIRCUITS

LOGIC DIAGRAM, 27 MHZ RECEIVER (TORQUEMETER)


100 KHZ INPUT
22
10PF
20T
# 26
100 KHZ OUTPUT TO SHAFT
20
20T
# 26
10 PF
1000V
27 MHZ TO RECEIVER
18

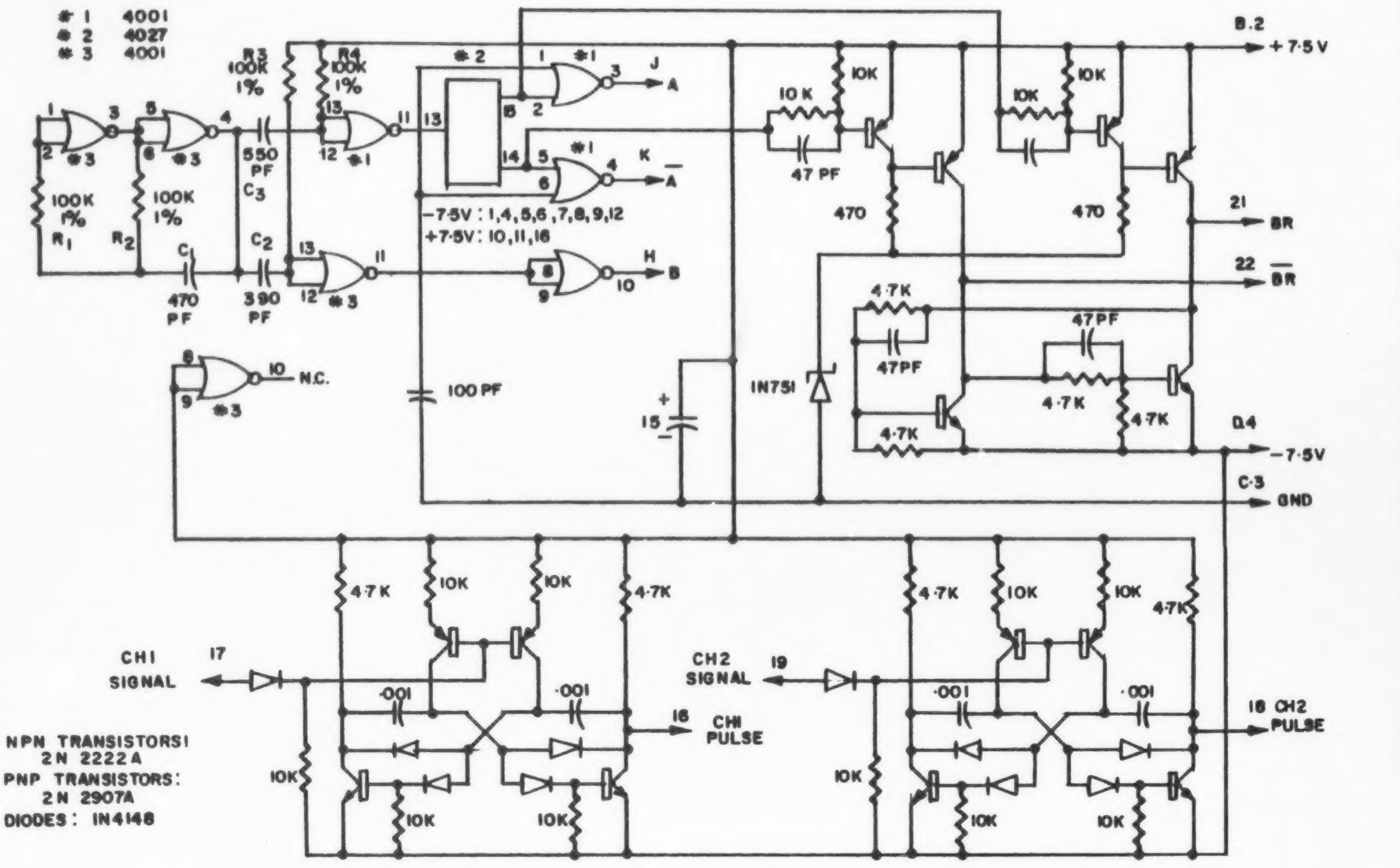
LOGIC DIAGRAM, SHAFT COUPLING CARD (TORQUEMETER)


IF OFFSET OSCILLATOR
CHANNEL FREQUENCY OSCILLATOR
CHANNEL FILTER
POWER OUTPUT Z PULSE MODULATOR
B.2
+7.5V
22
470
·001
100 K
3
5
270 PF
4
2065
2
1
10K
BR.
CHANNEL FREQUENCY -455KHZ
12½T # 22EN 3/16" DIA. 7/16" LONG TAP CT ±1½T
100 K
100 PF
·01
SEC: 12T # 22EN.CT 3/16" DIA. 7/16" LONG.
PRI: 2T # 22EN. CT WOUND OVER SEC.
12T # 22EN 3/16" DIA. 3/8" LONG
100 PF
100 PF
12T # 22 EN. CT. 3/16" DIA. 1/2" LONG.
50PF
100PF
47K
2PF
100 PF
SEC: 3T # 22 EN. OVER PRIMARY
PRI: 12½T # 22 EN CT. 3/16" DIA 7/16" LONG.
0·1
17
16
T
U
C·3
GND
10K
19
CH.1 PULSE
10K
20
CH.2 PULSE
+15V
A1
GND.
C.3
-15V
E·5
400 µH
195T # 26
400 µH
195T # 26
120T # 26
120T # 26
680T # 30
3·1 M.H
620 PF
20T # 30
10PF
20T # 30
10PF
9 INPUT OUTPUT
K
GND.

LOGIC DIAGRAM, 27 MHZ TRANSMITTER - DIPLEXES AND POWER SUPPLY (TORQUEMETER)

8/1979

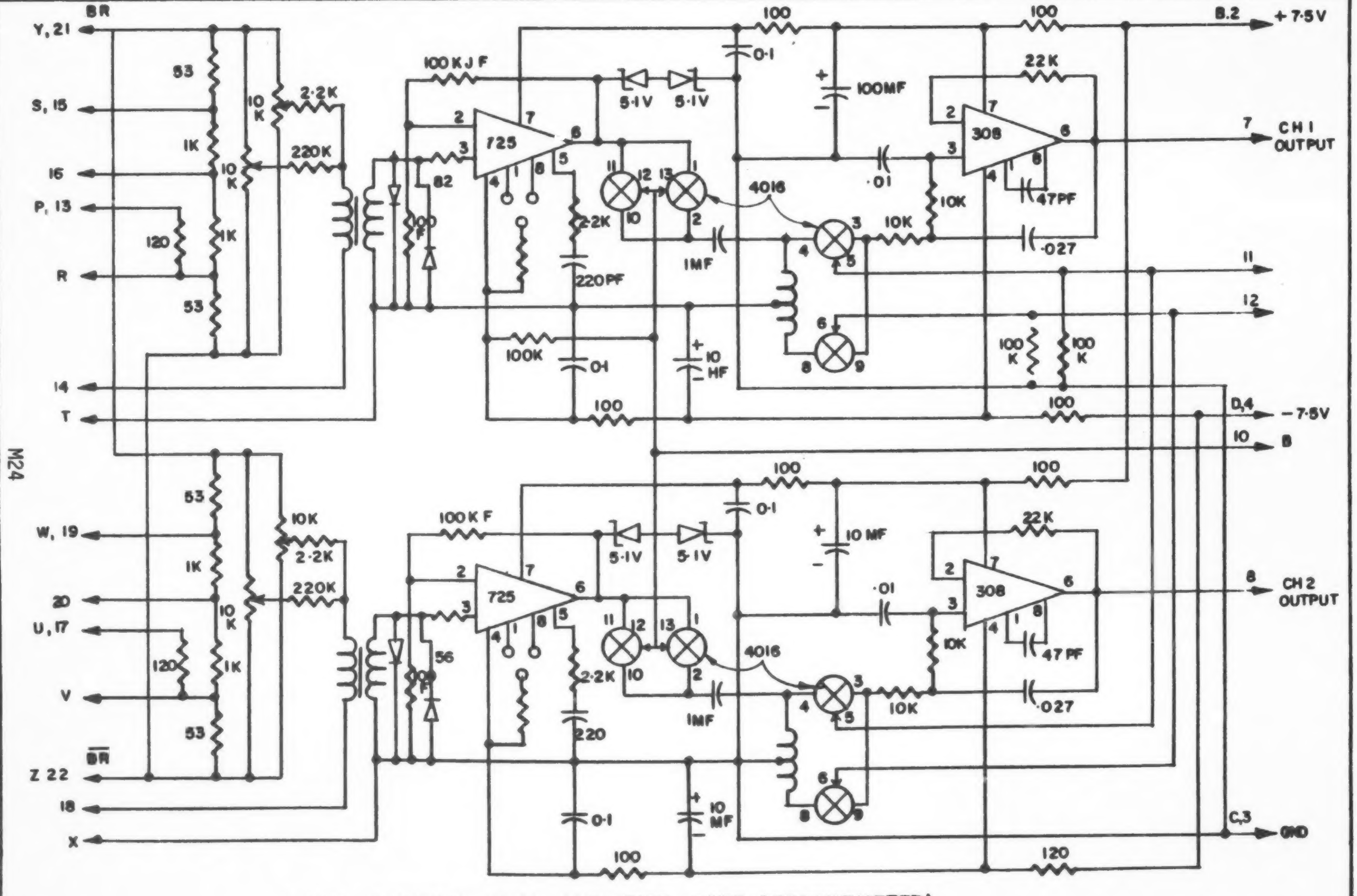
3501 - 406


#1 4001
#2 4027
#3 4001
R3 100K 1%
R4 100K 1%
100K 1% R1
100K 1% R2
C1 470 PF
C2 390 PF
550 PF C3
#2
#1
#3
J A
K A
H B
N.C.
-7.5V : 1,4,5,6,7,8,9,12
+7.5V : 10,11,16
100 PF
15
+
-
10K
10 K
47 PF
470
1N751
4.7K
47PF
B.2 +7.5V
21 BR
22 BR
D.4 -7.5V
C.3 GND
CH1 SIGNAL 17
CH2 SIGNAL 19
16 CH1 PULSE
18 CH2 PULSE
.001
NPN TRANSISTORS: 2N 2222A
PNP TRANSISTORS: 2N 2907A
DIODES: 1N4148

LOGIC DIAGRAM, BRIDGE SUPPLY CARD (TORQUEMETER)

8/1979

3501 - 407

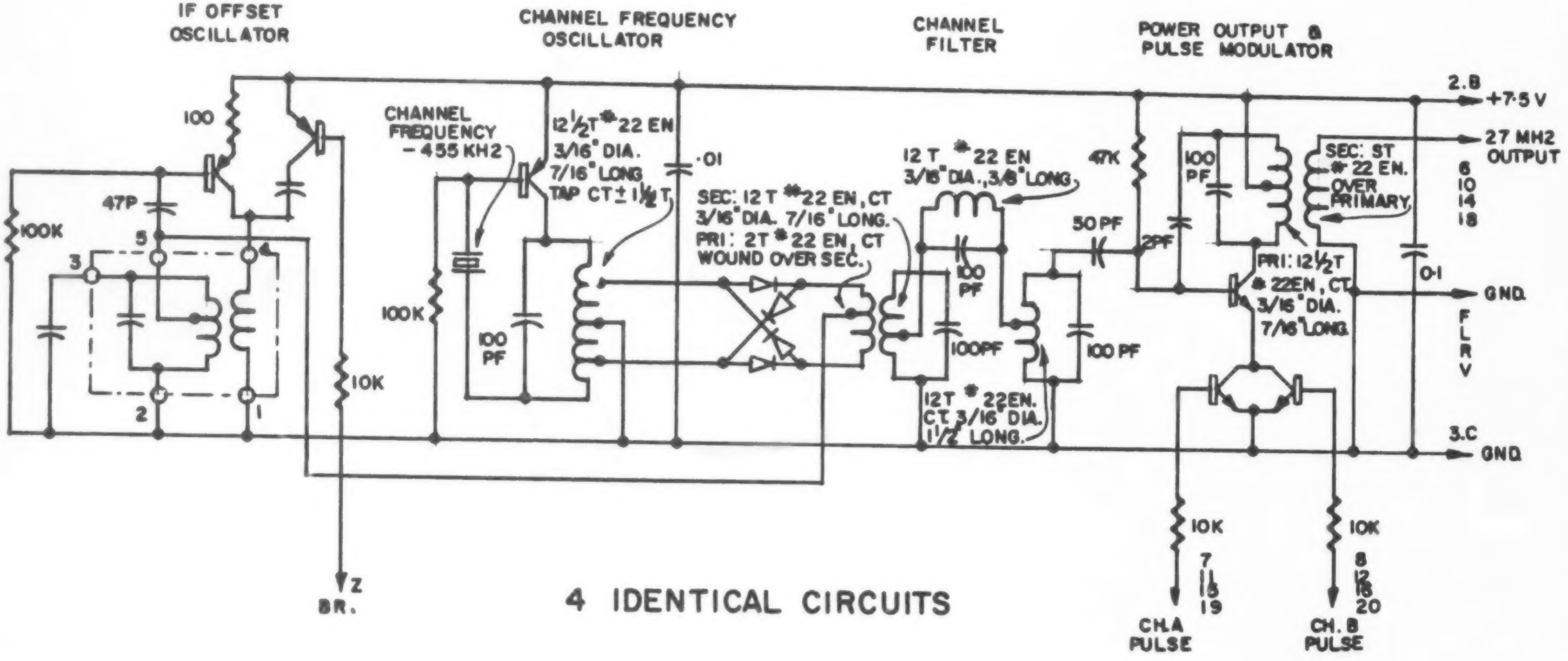

Y, 21
BR
S, 15
16
P, 13
R
14
T
W, 19
20
U, 17
V
BR
Z 22
18
X
53
1K
1K
53
120
10 K
10 K
2·2K
220K
10K
2·2K
220K
100 K J F
100 K F
82
56
100 F
725
2
3
7
6
4
1
8
5
2·2K
220PF
220
100K
0·1
100
5·1V
5·1V
11
12
13
1
10
2
4016
1MF
3
4
5
6
8
9
10 HF
10 MF
0·1
100
100MF
10 MF
·01
10K
10K
308
22K
47PF
·027
100 K
100 K
120
B.2
+ 7·5V
7
CH 1 OUTPUT
11
12
D,4
− 7·5V
10
B
8
CH 2 OUTPUT
C,3
GND

M24

LOGIC DIAGRAM, DUAL AMPLIFIER CARD (TORQUEMETER)

8/1979

3501 - 408

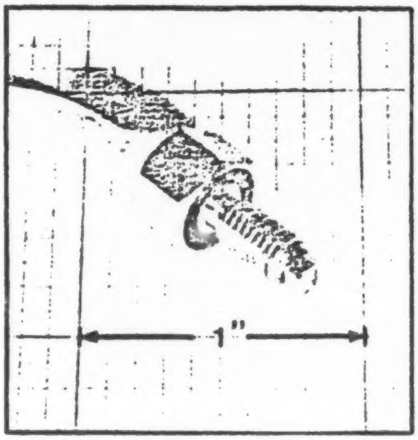

IF OFFSET OSCILLATOR
CHANNEL FREQUENCY OSCILLATOR
CHANNEL FILTER
POWER OUTPUT & PULSE MODULATOR
100
47P
100K
3
5
4
2
1
10K
Z
BR.
CHANNEL FREQUENCY -455 KH2
12½T #22 EN 3/16" DIA. 7/16" LONG TAP CT ± 1½T
.01
100K
100 PF
SEC: 12 T #22 EN, CT 3/16" DIA. 7/16" LONG.
PRI: 2T #22 EN, CT WOUND OVER SEC.
12 T #22 EN 3/16" DIA., 3/8" LONG.
100 PF
100PF
12T #22EN. CT 3/16" DIA. 1½" LONG.
100 PF
50 PF
47K
2PF
100 PF
SEC: ST #22 EN. OVER PRIMARY
PRI: 12½T #22EN, CT 3/16" DIA. 7/16" LONG
0.1
2.B
+7.5 V
27 MH2 OUTPUT
6 10 14 18
GND.
F L R V
3.C
GND.
10K
7 11 15 19
CH.A PULSE
10K
8 12 16 20
CH. B PULSE
4 IDENTICAL CIRCUITS

LOGIC DIAGRAM, 27 MHZ TRANSMITTER CARD (TORQUEMETER)

8/ 1979

3501-409

**Entran Devices, Inc.**



# EPS-1032 Series-Low Range Miniature Pressure Transducers

- 5 PSI TO 50 PSI RANGES
- 10-32 THREAD MOUNTING
- STAINLESS DIAPHRAGM

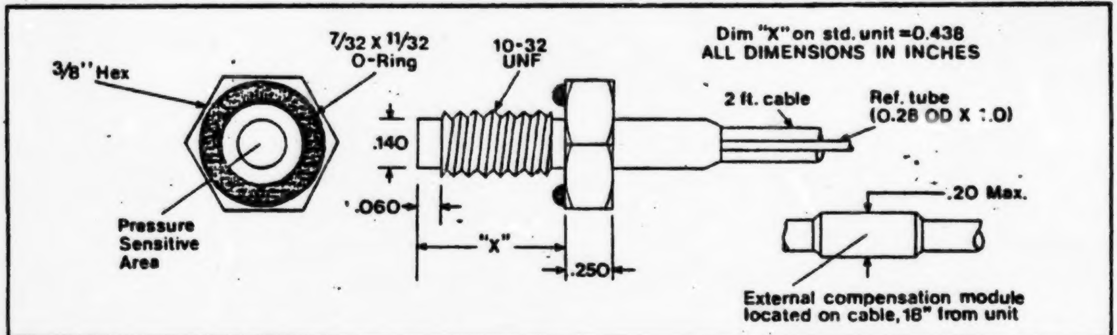
The EPS-1032 Series Pressure Transducer is a new thread mounted pressure sensor which measures static and dynamic pressures. The EPS offers a full scale output of up to 125mV for a 6 VDC or AC excitation with a combined non-linearity and hysteresis to ±¼%F.S. The transducer's useful frequency range is 20% of its resonant frequency.

The EPS-1032 is fabricated from stainless steel in a 10-32 UNF threaded housing (Metric thread also available) with an O-Ring seal. The standard EPS-1032 has a length of 7/16" from sealing surface to flush diaphragm. A customer specified length from ¼" to 1½" can be manufactured for a small additional charge. The standard transducer is supplied with 2 feet of teflon insulated cable with the compensation module located 18" from the sensor. Internal compensation is also available as an option.

The EPS is a semiconductor strain gage device and available in full scale ranges from 5 psi to 5000 psi in psig, psis, psia and psid. For ranges above 50 psi, see bulletin EPSH1032-473. For ranges above 5000 psi, contact Entran directly.

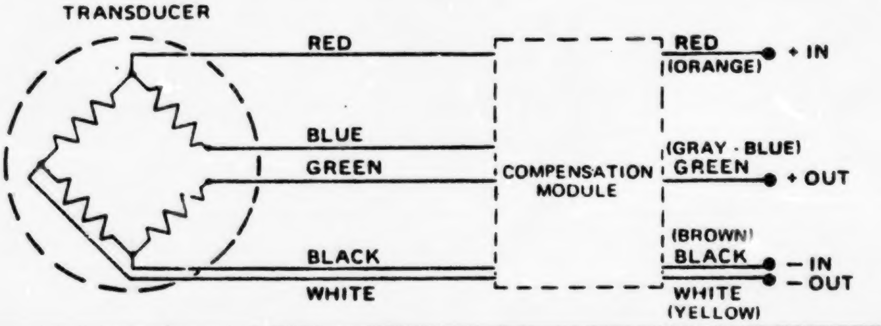
## SPECIFICATIONS

| MODEL | EPS-1032 -5 | EPS-1032 -10 | EPS-1032 -15 | EPS-1032 -30 | EPS-1032 -50 |
|---|---|---|---|---|---|
| RANGE psi | 5 | 10 | 15 | 30 | 50 |
| OVER-RANGE psi | 50 | 50 | 50 | 60 | 100 |
| SENSITIVITY mV FS. (nom.) | 15 | 25 | 30 | 60 | 100 |
| RESONANT FREQUENCY (nom.) | 45 KHz | 50 KHz | 65 KHz | 70 KHz | 75 KHz |
| INPUT IMPEDANCE (nom.) | 500 ohms: 280 ohms optional | | | | |
| OUTPUT IMPEDANCE (nom.) | 250 ohms: 140 ohms optional | | | | |
| EXCITATION | 6.0 V DC or AC: For other excitation voltages, specify at time of order. | | | | |
| COMBINED NON-LINEARITY and HYSTERESIS | ±1% F.S. | | | | |
| REPEATABILITY | 0.25% | | | | |
| RESOLUTION | Infinite | | | | |
| THERMAL ZERO SHIFT | ±4% F.S./100°F | | ±3% F.S./100°F | ±2% F.S./100°F | |
| THERMAL SENSITIVITY SHIFT | ±2%/100°F | | | | |
| COMPENSATED TEMP. RANGE | 80°F to 180°F (25°C to 80°C) Can be compensated over any portion of operating temp. | | | | |
| OPERATING TEMP. RANGE | −40°F to 250°F (−40°C to 121°C) Higher and lower temperature ranges are available. | | | | |


3/8'' Hex
7/32 x 11/32 O-Ring
10-32 UNF
.140
.060
"X"
.250
Pressure Sensitive Area
Dim "X" on std. unit =0.438
ALL DIMENSIONS IN INCHES
2 ft. cable
Ref. tube (0.28 OD X 1.0)
.20 Max.
External compensation module located on cable, 18" from unit

**EPS-1032 I-XX-(.XX)**

Series — Internal Compensation Option — Range — Custom Screw Length Option: desired length (Dimension "X") in inches (from .25 to 1.50).


TRANSDUCER
RED
BLUE
GREEN
BLACK
WHITE
COMPENSATION MODULE
RED (ORANGE)
+ IN
(GRAY - BLUE) GREEN
+ OUT
(BROWN) BLACK
− IN
− OUT
WHITE (YELLOW)

**Entran Devices, Inc.**
145 Paterson Ave.
Little Falls, N. J. 07424
(201) 785-4060

Specifications subject to change without notice.

**Entran Devices, Inc.**

## Pressure Calibration

PLEASE READ TRANSDUCER OPERATING INSTRUCTIONS BEFORE POWERING UNIT

Model No.: EPS-1032-50 Serial No.: 18G8G-H2-2

Type: Minaiture Pressure Transducer

Range: 50 psi g Overrange 100 psi g

Recommended Excitation: 6.0 V DC or AC Max. Voltage: 8.0 V

Pressure Reference: ☐ psia ☐ psis ☒ psig ☐ psid

Operating Temperature Range: -40 °F to 250 °F

Compensated Temperature Range: 80 °F to 180 °F

CAUTION: DO NOT PRESS ON PRESSURE SENSITIVE AREA WITH SHARP OBJECT

### CALIBRATION DATA

Excitation: 6.000 V DC

Sensitivity: 1.59 mV/psi g at 77 °F

Zero Offset: mV

Thermal Sensitivity Shift: mV/100°F <±2 %/100°F

Thermal Zero Shift: mV/100°F <±2 %FS/100°F

Combined Non-Linearity ad Hysterisis: ±1% F.S.

Non-Linearity: Hysterisis

Repeatability: Descriptive:

Descriptive: Installation: Torque tighten to 5 in/Lbs.

### WIRING

+ Input: ☒ Red ☐ Orange ☐ Pin + Output: ☒ Green ☐ Blue ☐ Pin

– Input: ☒ Black ☐ Brown ☐ Pin – Output: ☒ White ☐ Yellow ☐ Pin

Shield: ☐ Pin ☐

Transducer Connector: Mating Connector:

Input Impedance 559 ohms Output Impedance 290 ohms

Signature: Date: 7-27-78

Form No. C002-1173

DVM 31553
DWT 14318

M28

**Entran Devices, Inc.**

# Pressure Calibration

PLEASE READ TRANSDUCER OPERATING INSTRUCTIONS BEFORE POWERING UNIT

Model No.: EPS-1032-50 Serial No.: 18G8G-H2-2

Type: Minaiture Pressure Transducer

Range: 50 psi g Overrange 100 psi g

Recommended Excitation: 6.0 V DC or AC Max. Voltage: 8.0 V

Pressure Reference: ☐ psia ☐ psis ☒ psig ☐ psid

Operating Temperature Range: -40 °F to 250 °F

Compensated Temperature Range: 80 °F to 180 °F

CAUTION: DO NOT PRESS ON PRESSURE SENSITIVE AREA WITH SHARP OBJECT

## CALIBRATION DATA

Excitation: 6.000 V DC

Sensitivity: 1.59 mV/psi g at 77 °F

Zero Offset: mV

Thermal Sensitivity Shift: mV/100°F <±2 %/100°F

Thermal Zero Shift: mV/100°F <±2 %FS/100°F

Combined Non-Linearity ad Hysterisis: ±1% F.S.

Non-Linearity: Hysterisis

Repeatability: Descriptive:

Descriptive: Installation: Torque tighten to 5 in/Lbs.

## WIRING

+ Input: ☒ Red ☐ Orange ☐ Pin
+ Output: ☒ Green ☐ Blue ☐ Pin

− Input: ☒ Black ☐ Brown ☐ Pin
− Output: ☒ White ☐ Yellow ☐ Pin

Shield: ☐ Pin ☐

Transducer Connector: Mating Connector:

Input Impedance 559 ohms Output Impedance 290 ohms

Signature: Date: 7-27-78

Form No. C002-1173

DVM 31553
DWT 14318

**Entran Devices, Inc.**

## Pressure Calibration

PLEASE READ TRANSDUCER OPERATING INSTRUCTIONS BEFORE POWERING UNIT

Model No.: EPS-1032-50 Serial No.: 28E8F-C7-2

Type: Miniature Pressure Transducer

Range: 50 psi g Overrange 100 psi g

Recommended Excitation: 6.0 V DC or AC Max. Voltage: 8.0 V

Pressure Reference: ☐ psia ☐ psis ☒ psig ☐ psid

Operating Temperature Range: -40 °F to 250 °F

Compensated Temperature Range: 80 °F to 180 °F

CAUTION: DO NOT PRESS ON PRESSURE SENSITIVE AREA WITH SHARP OBJECT

### CALIBRATION DATA

Excitation: 6.000 V DC

Sensitivity: 1.49 mV/psi g at 77 °F

Zero Offset: mV

Thermal Sensitivity Shift: mV/100°F <±2 %/100°F

Thermal Zero Shift: mV/100°F <±2 % FS/100°F

Combined Non-Linearity ad Hysterisis: ±1.5%

Non-Linearity: Hysterisis

Repeatability: Descriptive:

Descriptive: Installation: Torque tighten to 5 in/Lbs.

### WIRING

+ Input: ☒ Red ☐ Orange ☐ Pin + Output: ☒ Green ☐ Blue ☐ Pin

− Input: ☒ Black ☐ Brown ☐ Pin − Output: ☒ White ☐ Yellow ☐ Pin

Shield: ☐ Pin ☐

Transducer Connector: Mating Connector:

Input Impedance 559 ohms Output Impedance 240 ohms

Signature: Date: 6-12-78

DVM 31553
DWT 14318

Form No. C002-1173

**Entran Devices, Inc.**

# Pressure Calibration

PLEASE READ TRANSDUCER OPERATING INSTRUCTIONS BEFORE POWERING UNIT

Model No.: EPS-1032-50 Serial No.: 28E8F-C8-3

Type: Miniature Pressure Transducer

Range: 50 psi g Overrange 100 psi g

Recommended Excitation: 6.0 V DC or AC Max. Voltage: 8.0 V

Pressure Reference: ☐ psia ☐ psis ☒ psig ☐ psid

Operating Temperature Range: -40 °F to 250 °F

Compensated Temperature Range: 80 °F to 180 °F

CAUTION: DO NOT PRESS ON PRESSURE SENSITIVE AREA WITH SHARP OBJECT

## CALIBRATION DATA

Excitation: 6.000 V DC

Sensitivity: 1.53 mV/psi g at 77 °F

Zero Offset: mV

Thermal Sensitivity Shift: mV/100°F ≤±2 %/100°F

Thermal Zero Shift: mV/100°F ≤±2 %FS/100°F

Combined Non-Linearity ad Hysterisis: ±1.1%

Non-Linearity: Hysterisis

Repeatability: Descriptive:

Descriptive: Installation: Torque tighten to 5 in/Lbs.

## WIRING

+ Input: ☒ Red ☐ Orange ☐ Pin    + Output: ☒ Green ☐ Blue ☐ Pin

− Input: ☒ Black ☐ Brown ☐ Pin    − Output: ☒ White ☐ Yellow ☐ Pin

Shield: ☐ Pin ☐

Transducer Connector:    Mating Connector:

Input Impedance 546 ohms    Output Impedance 254 ohms

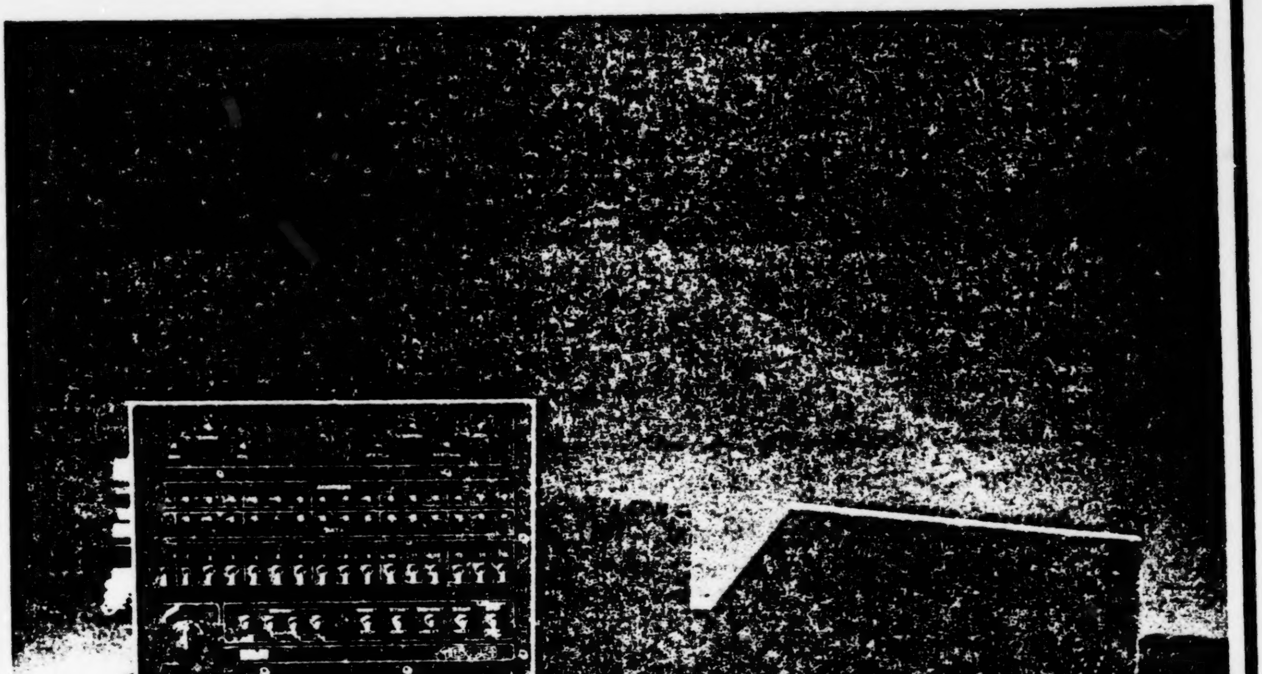
Signature:    Date: 6-12-78

DVM 31553
DWT 14318

Form No. C002-1173

**ROLM** MIL-SPEC Computers

# MODEL 1603A DATA SHEET



ROLM CORPORATION 4900 Old Ironsides Drive, Santa Clara, California 95050 • (408) 988-2900 • TWX 910 338-7350

The ROLM® Model 1603A (AN/UYK-27(V)) is one of ROLM's expanding family of rugged processors designed for severe environment and high-reliability applications. The 1603A provides the computing capability of the earlier Model 1603 computer – with an increased capacity for up to 32K words of memory in a single chassis. The 1603A is a 16-bit general-purpose processor, compatible with the earlier Model 1601 and the Model 1602. The low price of the 1603A, together with ROLM's field-proven construction techniques, extensive I/O capabilities and complete software support, make the Model 1603A one of the most economical and versatile rugged computer systems available today.

The 1603A is packaged in an ATR* chassis which accommodates the CPU module, up to six I/O interface modules, an Extended Arithmetic Unit (EAU) module, two 16K core memory modules (32K words maximum), two memory option modules, a real-time clock, and the power supply. The Control Panel, which can be located on the front of the chassis, provides all controls and indicators necessary for operation. The processor uses the standard ROLM/NOVA® instruction set, with 1.2 μsec add, 2.4 μsec load/store, and 2.15/2.75 μsec I/O instructions. The optional EAU provides multiply/divide execution in 7.7 μsec as well as N-bit shift/rotate instructions.

- Designed to meet MIL-E-5400, MIL-E-16400 Environmental Specifications
- Up to 32K words of Core Memory, two Memory Option Module slots, and a Real-Time Clock
- Extended Arithmetic Unit (EAU) slot
- Optional Remote Control Panel
- Hardmount, ATR and RETMA Rack-Mounting Options
- Standard, Wide, and Extreme Operating Temperature Range Options
- Software Compatible with ROLM 1600-series Computers
- Extensive Software Support Proven in over 20,000 Installations

## GENERAL DESCRIPTION

The Model 1603A is a 16-bit general-purpose computer designed for severe environment applications. The 1603A uses the same rugged packaging and conductive cooling techniques field-proven on the 1601, 1602, and 1603 computers. The basic chassis is designed for ATR rack mounting; 19-inch RETMA rack adapters and other mounting provisions are optional.

An integral control panel permits manual data entry, examination of stored data, and operational control of the processor. An optional Model 1637 Remote Control Panel is designed to connect by cable to the processor, allowing for each removal or remote mounting.

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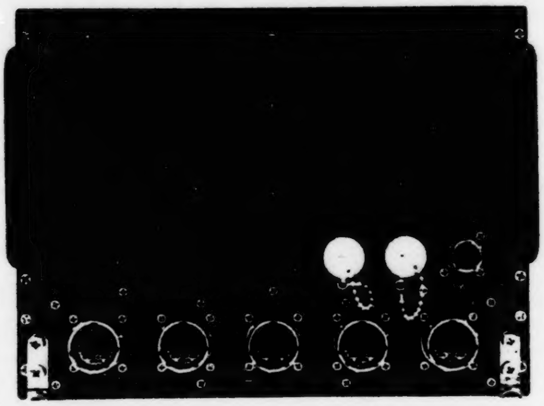
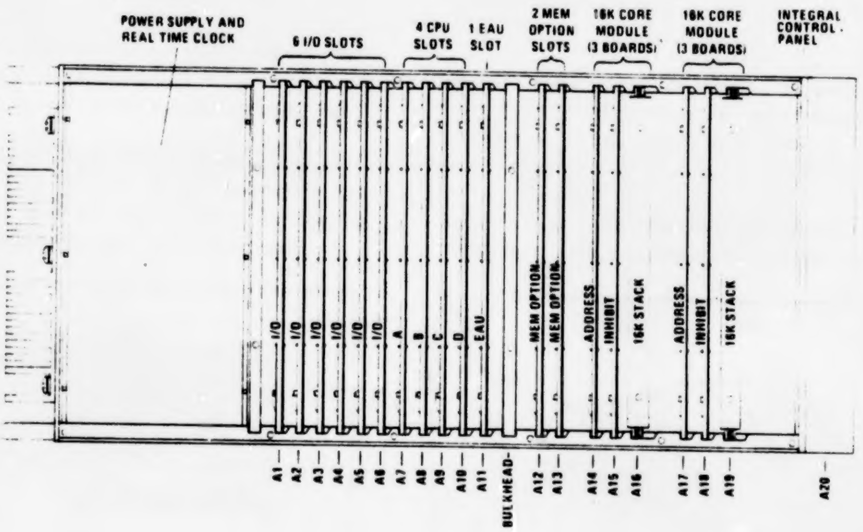
*Airline Transport Radio, MIL-STD-91403.

*An Integral Control Panel or Remote Control Panel provide all controls and indicators necessary for operation.*



*The 47-440 Hz power supply meets MIL-STD-704A at 400 Hz and is a field replaceable module.*


POWER SUPPLY AND REAL TIME CLOCK
6 I/O SLOTS
4 CPU SLOTS
1 EAU SLOT
2 MEM OPTION SLOTS
16K CORE MODULE (3 BOARDS)
16K CORE MODULE (3 BOARDS)
INTEGRAL CONTROL PANEL
I/O
I/O
I/O
I/O
I/O
I/O
A
B
C
D
EAU
MEM OPTION
MEM OPTION
ADDRESS
INHIBIT
16K STACK
ADDRESS
INHIBIT
16K STACK
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
BULKHEAD
A12
A13
A14
A15
A16
A17
A18
A19
A20

MODEL 1603A CONFIGURATION

The optional Model 1623 Extended Arithmetic Unit provides the 1603A with single-word instructions for multiplication, division, and N-bit shifts. For system applications which require more than six I/O slots, Model 2149 I/O Expansion Chassis can be connected to the CPU to provide additional I/O interface capacity.

The 1603A employs conductive cooling of internal components by transferring heat from components to the case. This eliminates the need for internal fans or coolants and results in a sealed case which provides structural strength and EMI protection.

## INSTRUCTION SET

ROLM 1603A instructions are grouped into the following categories:

- *Arithmetic/Logical* – to manipulate the contents of four accumulators and the carry flag. All arithmetic and logical functions are performed using the accumulators.
- *Memory Reference* – to move data between memory and registers or modify memory contents (includes jump instructions).
- *Programmed I/O* – to move data between CPU registers and I/O devices and to control interfaces and external devices.

When the Extended Arithmetic Unit option is installed, a fourth category is available:

- *Extended Arithmetic Instructions* – an extension of the instruction set which includes multiply, divide, shift and rotate instructions.

The complete 1603A instruction set is shown on the back panel of this data sheet.

## MEMORY

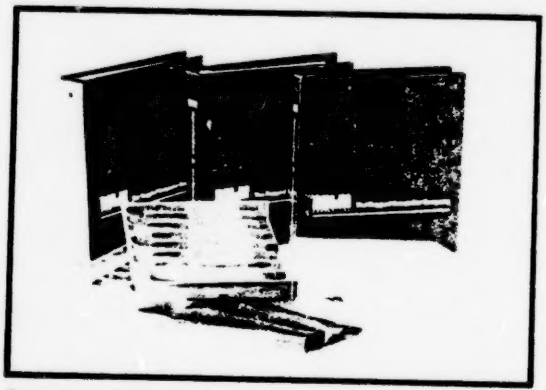
The 1603A is supplied with a 16K-word core memory module, consisting of three circuit boards. Memory cycle time is 1.2 μsec. Space is provided for an additional 16K-word core memory module. This permits up to 32K words of core memory within the computer chassis. Two memory option slots for semiconductor ROM are provided. If the EAU module is not installed, a third memory option module can be added.

## INPUT/OUTPUT

Six I/O interface slots are provided in the 1603A computer chassis. Since several of the standard ROLM I/O interfaces allow two or more devices to be interfaced by using a single module, most applications can now be handled by a single chassis.

The 1603A utilizes the I/O-Bus architecture proven successful in earlier ROLM 1600-series computers and the Data General Corporation NOVA commercial computers. Sixteen levels of programmable priority interrupt, with an average latency of 2.5 μsec, offer powerful real-time I/O processing capability. Direct Memory Access (DMA) I/O is standard, with 768,000 words/second input and 526,000 words/second output rates attainable.

An extensive selection of peripheral devices and general-purpose I/O interfaces are available to complement the power and capability of the I/O structure. As many as 61 I/O devices may be addressed by the processor.



*Extensive software and complete documentation are provided with each system.*

## SOFTWARE

The ROLM 1600-series computer line, including the Model 1603A, is supported by the most extensive software library available for rugged computers. A full spectrum of assemblers, loaders, editors, compilers, interpreters, debuggers, and utility routines are offered – together with a choice of operating systems and languages designed to make your software development task as efficient as possible.

## OPERATING SYSTEMS

**SOS** *(Stand-Alone Operating System)* – Contains I/O drivers for peripherals. Fully compatible sub-set of RTOS and RDOS.

**RTOS** *(Real-Time Operating System)* – A small memory-resident general purpose multitask monitor for a wide variety of real-time applications. Fully compatible sub-set of RDOS.

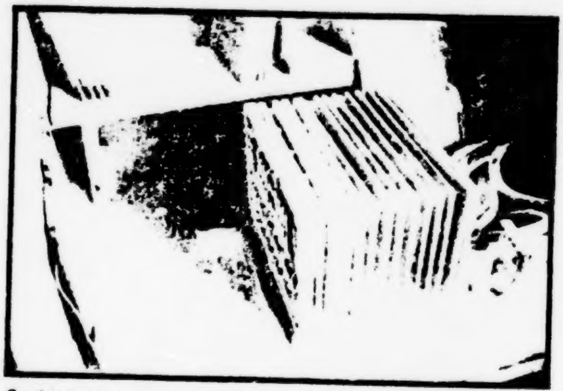
**RDOS** *(Real-Time Disk Operating System)* – Supports all major peripherals, programs, and languages and provides an extremely efficient development capability.

## LANGUAGES

*Real-Time FORTRAN IV* – This language includes a sophisticated file structure with flexible I/O, full mixed-mode arithmetic and other extensions. The compiler produces re-entrant code.

*ALGOL* – A superset of ALGOL 60 with either free-form I/O or formatted output, recursive and re-entrant procedures, and many other extensions.

*BASIC* – A high-level, core-resident interpreter providing rapid and easy programming capability.



*Sophisticated environmental testing ensures the field-proven reliability of ROLM computers.*

## OPTIONS AVAILABLE

1603A options include: Extended Arithmetic Unit, real-time clock, additional 16K words of core memory for a total of 32K words, a remote Control Panel, Read-Only-Memory Modules, three different operating-temperature ranges.

ROM or PROM memory modules may contain custom code or standard loader/utility routines with a memory diagnostic. Mounting arrangements include hard-mount, RETMA rack mount, or ATR rack mount. The standard operating case temperature range is 0° to +65°C; wide (-25° to +75°C) or extreme (-55°C to +95°C) ranges are optional.

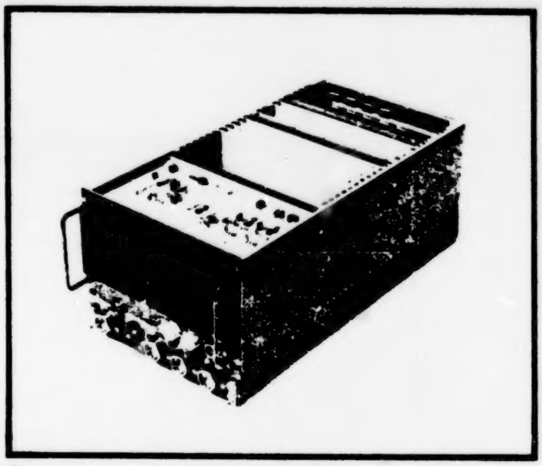
ROLM offers with the Model 1603A a full line of peripherals, interfaces and accessories including magnetic tape and disk equipment, paper tape readers and punches, card readers, line printers, analog and digital input/output, NTDS and other communications interfaces. In addition, designer interface modules facilitate your design and construction of custom-built circuit modules for special applications.

Please see the latest ROLM catalog or call your nearest ROLM Sales Office for a further description of available equipment.

## SUPPORT

Service has always been a prime consideration at ROLM. All equipment is designed to minimize the need for service, and a complete documentation package is provided with every system.

Extensive diagnostic routines are provided with each system. A one-week programming and a one-week maintenance course are provided at no extra charge with the purchase of each *unique* system. Most standard parts are in inventory at the factory and can be delivered to almost anywhere in the U.S. and to many parts of Europe within 48 hours. ROLM maintains a staff of trained representatives who are available during ROLM's normal working hours to assist customers with maintenance questions, provide emergency on-site repairs, and coordinate factory repair of modules.



*The modularity and accessibility of 1603A components enhance the ease of service and installation.*

## SPECIFICATIONS

The ROLM 1603A computer is designed to meet the environmental specifications of MIL-E-5400 Class II and MIL-E-16400.

| | |
|---|---|
| Case Temperature | Standard: 0° to 65°C<br>Wide: -25°C to +75°C<br>Extreme: -55°C to +95°C |
| Vibration | 10g, 5-2000 Hz, with vibration isolators (MIL-E-5400, curve IVa)<br>2g, 5-2000 Hz, hard-mounted (MIL-E-5400, curve IIa) |
| Shock | 15g, 11 msec (MIL-E-5400)<br>400 lb. hammer, with isolators (MIL-S-901C) (MIL-E-16400) |
| Humidity | 95% Relative |
| EMI | MIL-STD-461A |
| Altitude | 80,000 ft. |
| Power | 47-440 Hz, 115 Vac, single phase. Operation per MIL-STD-704A, Category B at 400 Hz. 100 watts typical (CPU + 16K core), 150 watts maximum (per chassis). |
| Chassis Size - ATR | 7.62" x 10.12" x 19.76" |
| Weight | 55 lb. |

## INSTRUCTION EXECUTION TIMES

*Many of the 1603A instructions have options, such as modify, test, etc., making several hundred additional instructions available (e.g., ADCZR: add the complement of source AC to destination AC, use 0 as base for carry bit, and rotate result right). The fundamental set is shown here.*

| Mnemonic | Description | Execution ( $\mu$s) | Notes |
|---|---|---|---|
| COM | Complement | 1.2 | (1) |
| NEG | Negate | 1.2 | (1) |
| MOV | Move | 1.2 | (1) |
| INC | Increment | 1.2 | (1) |
| ADC | Add Complement | 1.2 | (1) |
| SUB | Subtract | 1.2 | (1) |
| ADD | Add | 1.2 | (1) |
| AND | And | 1.2 | (1) |
| LDA | Load Accumulator | 2.4 | (2) |
| STA | Store Accumulator | 2.4 | (2) |
| ISZ | Increment and Skip if Zero | 3.0 | (2)(5) |
| DSZ | Decrement and Skip if Zero | 3.0 | (2)(5) |
| JMP | Jump | 1.2 | (2) |
| JSR | Jump Subroutine | 1.2 | (2) |
| DOA, B, C | Data Out | 2.75 | (3) |
| DIA, B, C | Data In | 2.15 | (3) |
| NIO | No I/O Transfer | 2.75 | (3) |
| SKP | I/O Skip | 2.0 | (5) |
| INTEN | Enable Interrupts | 2.75 | |
| INTDS | Disable Interrupts | 2.75 | |
| READS | Read Data Switches | 2.15 | |
| INTA | Interrupt Acknowledge | 2.15 | |
| IORST | I/O Reset | 2.15 | |
| MSKO | Mask Out | 2.75 | |
| SKPXX 77 | Test ION, Power Fail | 2.0 | (5) |
| UMPA, UMPY | Unsigned Multiply | 7.7 | (4) |
| UDVD | Unsigned Divide | 7.7 | (4) |
| | if overflow occurs | 2.65 | (4) |
| LLSHD, n | Left Logical Shift | 3.05–7.4 | (4) |
| RLSHD, n | Right Logical Shift | 3.05–7.4 | (4) |
| LASHD, n | Left Arithmetic Shift | 3.05–5.0 | (4) |
| RASHD, n | Right Arithmetic Shift | 3.05–5.0 | (4) |
| LROTD, n | Left Circular Shift | 3.05–5.0 | (4)(6) |
| RROTD, n | Right Circular Shift | 3.05–5.0 | (4)(6) |

*Notes:*

1. *Add 0.15 microseconds if left shift or right shift option is taken, 0.6 if skip is executed.*
2. *For indirect addressing, add 1.2 microseconds for each normal level, 1.8 microseconds for each autoincrement or autodecrement level.*
3. *Times shown are for instructions with device codes 02–76 octal.*
4. *Available only with optional EAU. Execution time is data dependent.*
5. *Add 0.6 microseconds if Skip is executed.*
6. *Not fully 1602 compatible.*

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**ROLM** MIL-SPEC Computers

# MODEL 3382 DATA SHEET
## FLOPPY DISK INTERFACE

## FEATURES

The ROLM® Model 3382 Floppy Disk Interface is part of the Model 3383 Floppy Disk System. The interface module provides the adaptive communication link between a ROLM CPU and the formatter/drive electronics in the disk system. Except for the speed and capacity, the features of the floppy disk system are similar to those found in disk cartridge systems: random access, large on-line storage, high-speed data transfer, removable magnetic media and convenient programming – especially when used with a ROLM disk-based operating system.

Model 3382 Floppy Disk Interface modules can operate systems with one to four drives. The Model 3383 Floppy Disk System includes an AED Model 6200P with two drives. A two-drive system is the minimum required to support RDOS. Data is transferred at high speed through the ROLM I/O bus under control of the Direct Memory Access (DMA) logic of any ROLM processor.

The ROLM diskette format of $77_{10}$ tracks of 16 sectors of 256 16-bit words is required by ROLM disk-based operating systems. This format yields a single-drive capacity of 315,392 16-bit words using double-density modified FM recording techniques. The on-line capacity of the system is 1,261,568 16-bit words using four disk drives. The unformatted single-drive capacity is 361,130 16-bit words.

## PROGRAMMING

The ROLM processor communicates with the Model 3382 Floppy Disk Interface by means of I/O instructions and formatter command words issued under program control. The Floppy Disk Interface device code is 31, with 71 reserved for a second interface module. Both device codes are supported by ROLM software. Other device codes may be used if ROLM software support is not required. Standard ROLM interrupt conventions are used with mask bit 7 (optionally 10) representing the Floppy Disk Interface.

Six I/O instructions are used. The output instructions are generally accompanied by floppy disk system command words required by the formatter. Combinations of instructions, command words, and status words direct the exchange of control, status, and data information between the processor and a Model 3383 Floppy Disk System.

**Instructions Used by the Model 3382 Floppy Disk Interface**

| Mnemonic | Output Instruction | Mnemonic | Input Instruction |
|---|---|---|---|
| DOA | Load Command Word Register | DIA | Read Minor Status Word |
| DOB | Load Memory Address Register | DIB | Read Memory Address Register |
| DOC | Load Word Count Register | DIC | Read Major Status Word |

**Definitions**

Command Word – Four types are used. Type 0 words specify the *Track* number when beginning an Initialize, Read, or Write operation. Type 1 words specify the track *Sector* for a subsequent Read or Write operation. Type 2 and Type 3 words are used to load the high-order and low-order bytes of the word count register. Receipt of a Type 3 word causes the formatter to enter the Initialize Write sequence. Type 2 and Type 3 words are used only when Initialize Start/Stop operation has been specified by a Type 0 command.

Input Minor Status Word – A formatter-originated word representing the condition of the logical drive unit last selected by a command. Provides initialization flag, identifies errors (if any), and identifies the data mark.

Input Major Status Word – Contains a count of words remaining to be transferred. The specified Accumulator (AC) will contain either a zero or the 2's complement of the number of words *not* transferred during last floppy disk DMA operation. Also describes error status of last transfer.

## INSTRUCTIONS

| | |
|---|---|
| **DOA** | Loads the selected Command Word into the I/O register. |
| **DOB** | Loads the Memory Address register with starting address of data to be transferred. |
| **DOC** | Loads Word Count register with contents of specified AC. |
| **DIA** | Reads Minor Status Word into a specified AC. |
| **DIB** | Reads Memory Address register into a specified AC. |
| **DIC** | Reads Major Status Word into specified AC. After execution, contents of specified AC should be zero. A residual value reflects the 2's complement of the number of words *not* transferred during a previous operation. Bit 1 will indicate an error condition. |

## EQUIPMENT SUPPLIED

The ROLM Model 3382 Floppy Disk Interface and internal wiring to the chassis bulkhead connector are factory-installed in either a processor chassis or an I/O expansion chassis. If the Floppy Disk Interface is ordered as part of a Model 3383 Floppy Disk System, a standard interconnect cable (Model 3860 Option 14) and connectors are included. Cable length is 8 feet. The single-board interface module is of standard ROLM construction, conductively cooled and equipped with thermal frame, alignment block and aluminum stiffener. Fork-type connectors on the interface module plug into mating connectors on the motherboard.

## MODEL 3382 INTERFACE OPTIONS

**Option 4, Alternate Device Code.** 71 for systems supported by ROLM software.

## MODEL 3383 SYSTEM OPTIONS

**Option 4, Alternate Device Code.** 71 for systems supported by ROLM software.

**Option 13, Custom Cable Length.**

**Option 30, RETMA Rack Mount.**

**Option 51, 230V, 50 Hz Supplied Power.**

**Option 80, Right Angle Backshells**

## ENVIRONMENTAL SPECIFICATIONS
### (Model 3382 Floppy Disk Interface)

| | |
|---|---|
| Size | 6.50" x 9.60" x .475" |
| Weight | 1.25 lbs. |
| Temperature | (measured on chassis external surface) -55°C to +95°C |
| Vibration | 10g, 5–2000 Hz with vibration isolators (MIL-E-5400, Curve IVa)<br>2g, hard-mounted (MIL-E-5400, Curve IIa) |
| Shock | 15g, 11 ms (MIL-E-5400): 400 lb hammer with isolators (MIL-E-16400 and MIL-S-901). |
| Humidity | 95% Relative |
| Altitude | 70,000 feet (21,336 meters) |

## PERFORMANCE
### (Model 3382 Floppy Disk Interface)

| | |
|---|---|
| Power | Power is supplied by processor chassis power supply or I/O expansion chassis power supply. ±5 Volts, 1 Amp |
| Thermal Dissipation | 5 watts (conductively cooled to ATR box side plates) |
| Transfer Rate | 31,250 16-bit words per second (500K bits/second) |

## DISK DRIVE PERFORMANCE
### (Model 3384 Floppy Disk Drive)

| | |
|---|---|
| Disk Rotation Speed | 360 rpm |
| Head Positioning Time | 11 ms per track |
| Average Latency Time | 83.5 ms/revolution |
| Number | Up to four Model 3384 Floppy Disk Drive Units may be installed in a Model 3383 Floppy Disk System. |

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**ROLM** MIL-SPEC Computers

# MODEL 3383 DATA SHEET

## FLOPPY DISK SYSTEM

### APPLICATION

The Model 3383 Floppy Disk System provides the ROLM family of MIL-SPEC computers with an inexpensive, replaceable media, random access, data storage system. The Model 3383 – the commercial-grade equivalent of the MIL-SPEC-qualified Model 3385/3386 Floppy Disk System – can access up to 2.5 megabytes of data, and transfer data at rates up to 500K bits/sec using the ROLM processor's Direct Memory Access (DMA) logic. With a track-to-track access time of 11 msec and average rotational latency of 83.5 msec, the 3383 may be used by the processor to access large blocks of data in real-time application.

The Model 3383 system is supported by three of ROLM's powerful operating systems – Real-Time Operating System (RTOS), Real-Time Disk Operating System (RDOS), and Resource Management Executive (RMX/RDOS). When two or more drives are used in the system, the Model 3383 satisfies the minimum designated disk equipment requirement for RDOS. The full capacity of the Model 3383 Floppy Disk System is realized in four, 630,784-byte drives.

The Model 3383 is available with a number of power, mounting and software programming options and includes the following major components:

**Standard**

- Model 3382 Floppy Disk Interface
- AED Model 6200P Chassis (includes power supply, formatter control panel, and two Model 3384 Floppy Disk Drives)
- Model 3860 55-Pin Signal Cable
- Model 5643 Floppy Disk (package of five disks)

**Optional**

- One or two additional Model 3384 Floppy Disk Drives (for a maximum of four drives per system)

When used with the ROLM operating systems, the Model 5643 floppy disk media is divided into $77_{10}$ tracks and 16 sectors, each sector containing 256 16-bit words. Total capacity in this format is 315,392 words/disk or 1,262 million words in a four-disk system. Unformatted single-drive capacity is 361,130 16-bit words.

### PROGRAMMING

The ROLM processor communicates with the Model 3383 Floppy Disk system by means of I/O instructions and formatter command words issued under program control. The Floppy Disk Interface device code is 31, with device code 71 available for a second interface module. Both device codes are supported by ROLM software. Other device codes may be used if ROLM software support is not required. Standard ROLM interrupt conventions are used with mask bit 7 (optionally 10) representing the Floppy Disk Interface.

Six I/O instructions are used. The output instructions are generally accompanied by floppy disk system command words required by the formatter. Combinations of instructions, command words, and status words direct the exchange of control, status, and data information between the processor and a Model 3383 Floppy Disk System.

**Instructions Used by the Model 3382 Floppy Disk Interface**

| Mnemonic | Output Instruction | Mnemonic | Input Instruction |
|---|---|---|---|
| DOA | Load Command Word Register | DIA | Read Minor Status Word |
| DOB | Load Memory Address Register | DIB | Read Memory Address Register |
| DOC | Load Word Count Register | DIC | Read Major Status Word |

### EQUIPMENT SUPPLIED

The ROLM Model 3382 Floppy Disk Interface module and associated internal wiring to the chassis bulkhead connector may be factory-installed in either a processor chassis or an I/O expansion chassis or may be retrofitted into existing systems by making wiring changes. The single-board module is of standard ROLM construction: conductively cooled and equipped with a thermal frame, alignment block and aluminum stiffener, and designed to meet Mil-Spec environmental requirements. Fork-type connectors on the interface module plug into mating connectors on the motherboard.

The AED Model 6200P chassis houses the power supply, formatter and from one to four AED Inc. Floppy Disk Drives. The formatter uses a double-density, modified frequency modulation (MFM) recording format and Read-before-Write address verification. It operates under control of the ROLM processor and contains independent drive electronics for each disk drive in the system – to a maximum of four.

The floppy disk drive used in the system is a commercial-grade unit which reads and writes on IBM-type floppy diskette media at a maximum data rate of 500K bits/sec. The read/write head is positioned by a precision lead screw mechanism at 11 msec/track; media rotation is 360 rpm.

## MODEL 3383 SYSTEM OPTIONS

**Option 04** – **Alternate Device Code.** $71_8$ for systems supported by ROLM software.

**Option 05** – **Alternate Mask Bit.** Mask bit 10 may be used instead of mask bit 7.

**Option 13** – **Custom Cable Length.**

**Option 30** – **RETMA Rack Mount.**

**Option 51** – **230V, 50 Hz Supplied Power.**

**Option 80** – **Right-Angle Backshells.**

## ENVIRONMENTAL SPECIFICATIONS

### Model 3382 Floppy Disk Interface

| | |
|---|---|
| Size | 6.50 in. x 9.60 in. x 0.475 in. (16.51 cm x 24.38 cm x 1.21 cm) |
| Weight | 1.25 lb (5.68 kg) |
| Temperature | (measured on chassis external surface) -55°C to +95°C |
| Vibration | 10g, 5-2000 Hz with vibration isolators (MIL-E-5400, Curve IVa)<br>2g, hard-mounted (MIL-E-5400, Curve IIa) |
| Shock | 15g, 11 ms (MIL-E-5400):<br>400 lb hammer with isolators (MIL-E-16400 and MIL-S-901) |
| Humidity | 95% Relative |
| Altitude | 70,000 feet (21,336 meters) |

### Model 3383 System Floppy Disk Formatter/Drive*

| | |
|---|---|
| Size | 10.5 in. high x 16.8 in. wide x 21.6 in. deep (26.7 cm x 42.7 cm x 54.8 cm) |
| Weight | 60 lb (27 kg) – 2 drives; 89 lb (40 kg) – 4 drives |
| Temperature | 10°C to 38°C |
| Humidity | 20% to 80% Relative with maximum wet bulb temperature at 25°C |
| Altitude | -500 ft to 10,000 ft (-152 m to 3048 m) |

## PERFORMANCE

### Model 3382 Floppy Disk Interface

| | |
|---|---|
| Power | Power is supplied by processor chassis power supply or I/O expansion chassis power supply. ±5 Volts, 1 Amp. |
| Thermal dissipation | 5 watts (conductively cooled to ATR box side plates) |
| Transfer rate | 31,250 16-bit words per second (500K bits/second) |

### Model 3384 Floppy Disk Drive

| | |
|---|---|
| Disk rotation speed | 360 rpm |
| Head positioning time | 11 ms per track |
| Average latency time | 83.5 ms |
| Number | Up to four Model 3384 Floppy Disk Drive Units may be installed in a Model 3383 Floppy Disk System |

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*ROLM offers a MIL-SPEC-qualified equivalent system – the Model 3385/3386 – for applications requiring MIL-SPEC hardware.

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# MODEL 3503 DATA SHEET

## REAL TIME CLOCK

## FEATURES

The Real Time Clock (RTC) provides the timing required to use ROLM Computers* for a wide variety of applications in real time processing and control systems. This clock provides interval timing which is independent of instruction execution times and all other processor functions. It is used to initiate a sequence of program interrupts at regularly recurring intervals. The program specifies the rate at which these interrupts occur – 10 Hz, 60 Hz, 100 Hz, or 1000 Hz – and activates the RTC when appropriate to the application.

A temperature-compensated crystal oscillator followed by a digital frequency divider assures excellent stability under typical operating conditions. Because no oven is used, warm-up time is minimal. In systems which require even greater accuracy or a different selection of interrupt rates, an external frequency standard may replace the internal oscillator and divider. If the frequency of the external standard is f, then the available program interrupt rates become f, $\frac{f}{10}$ and $\frac{f}{100}$.

An auxiliary output supplies a continuous, fixed frequency signal for use by other I/O devices. A wiring jumper selects the output frequency from the following set: 500 or 1500 Hz, or any binary multiple of 1500 Hz up to 1.536 MHz.

## PROGRAMMING

The processor communicates with the real time clock using DOA and NIO instructions. The device code is normally $14_8$, optionally $54_8$. The interrupt mask bit is 13.

Bits 14 and 15 of the accumulator selected by the DOA instruction contain a 2-bit code specifying the clock rate desired.

| AC Bits | | Frequency |
|---|---|---|
| 14 | 15 | |
| 0 | 0 | 60 Hz |
| 0 | 1 | 10 Hz |
| 1 | 0 | 100 Hz |
| 1 | 1 | 1000 Hz |

The function codes for Start and Clear operate in the usual manner, as do the skip instructions sensing the Busy and Done conditions.

After the Start function causes the RTC to enter its Busy state, the next clock pulse at the selected rate advances Busy to Done and initiates an interrupt request if the mask bit is clear. Frequency selection by DOA need be done only once. Thereafter, each successive interrupt can be serviced using an NIOS instruction. The elapsed time from start to the first interrupt may be any amount up to the full period of the clock. Subsequent interrupts occur at the selected rate as long as the program gives an NIOS before the next interval expires.

IORST resets the clock frequency to 60 Hz, in addition to performing the usual general reset functions.

## OPTIONS

Several options are available to increase the flexibility of a user's system:

| OPTION | DESCRIPTION | |
|---|---|---|
| 4 | Alternate Device Code (54) | |
| 6 | External frequency input | |
| 10 | Auxiliary Output | 0.5 kHz |
| 11 | Auxiliary Output | 1.5 kHz |
| 12 | Auxiliary Output | 3.0 kHz |
| 13 | Auxiliary Output | 6.0 kHz |
| 14 | Auxiliary Output | 12.0 kHz |
| 15 | Auxiliary Output | 24.0 kHz |
| 16 | Auxiliary Output | 48.0 kHz |
| 17 | Auxiliary Output | 96.0 kHz |
| 18 | Auxiliary Output | 192.0 kHz |
| 19 | Auxiliary Output | 384.0 kHz |
| 20 | Auxiliary Output | 768.0 kHz |
| 21 | Auxiliary Output | 1536.0 kHz |

## EQUIPMENT SUPPLIED

This module is of the same construction as ROLM CPU modules. It is conductively cooled and includes the aluminum "cookie sheet" type stiffener. Fork-type connectors plug into pre-installed female connectors in one of the slots reserved for I/O options in the CPU or in an I/O Expansion Chassis.

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*except the 1603. See Model 3504.

## SPECIFICATIONS

| | |
|---|---|
| Oscillator | |
| Initial Accuracy @ 25°C | ± .002% |
| Temperature stability, −55°C to +95°C case | ± .005% |
| Warm-up time to achieve ± .005% accuracy | None |
| Interrupt Rates | 10, 60, 100, 1000 Hz |
| External Generator Input | Two TTL loads plus resistive termination, 330 ohms to +5 volts and 390 ohms to ground |
| Auxiliary Output | SN5400 series TTL |
| Auxiliary Frequencies | 500, 1500 Hz, 3, 6, 12, 24, 48, 96, 192, 384, 768, 1536 kHz |
| Net Weight | 1.1 lb. |
| Power Requirements (supplied by computer power supply) | +5 volts, 300 ma<br>+12 volts, 10 ma<br>−12 volts, 30 ma |
| Thermal Dissipation | 2 watts (conductively cooled to ATR box side plates) |
| Environmental | Same as 1600-Series Computers |

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# MODEL 3315 DATA SHEET

## TERMINAL PRINTER

## FEATURES

- Offers true 300 bps operation
- 30/60 cps, switch-selectable
- Provides 96 characters, upper/lower case, ASCII format
- Operates quietly
- Provides top-of-form adjust/control
- Handles up to six-part forms
- Offers lead-screw print head drive mechanism
- Uses EIA RS-232C interfacing
- Accepts 4-inch (10.1 cm) to 15-inch (38.1 cm) form widths.
- Offers View Mode feature
- Includes 40-character print buffer
- Provides standard typewriter keyboard format
- Operates as off-line device
- Uses long-life reel-type ribbon
- Includes paper basket

## DESCRIPTION

The ROLM® Model 3315 Terminal Printer is built by Data General Corporation, and is identical to the DG Model 6040 DASHER$^{TM}$ Printer. Two optional features of the DG Model 6040 are included as standard equipment in the ROLM Model 3315: Top of Form Control and the Paper Basket.

Model 3315 Terminal Printers are reliable units for all data input/output applications. The standard typewriter keyboard provides an extra measure of utility: the printer can be used off-line as a typing device. Both 30 cps and 60 cps speeds are available (switch-selectable). Additional features make the Model 3315 Terminal Printer especially useful in a program development environment. The user-selectable View-Mode feature is one such feature. The View Mode moves the printing head away from the last characters typed, to make proofing easier. The carriage is driven by a lead-screw mechanism that precisely registers the head horizontally and vertically.

*The Model 3315 Terminal Printer can also serve as an off-line typewriter.*

The Model 3315 Terminal Printer was designed for high reliability and easy maintainability. Components are grouped into five areas: electronics, ribbon drive, print head and carriage drive, keyboard and operator control panel, and paper feed. Doors provide access to the interface, control circuits, and decoder, which are mounted on a single, easily removable printed circuit board; access is also provided to the adjacent power supply. The reel drive and other components are readily accessible from the top of the unit.

---

$^{TM}$DASHER is a trademark of Data General Corporation.

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## PRINTING SPEEDS

The Model 3315 Terminal Printer permits operation at 300 or 600[*] bps on a switch-selectable basis. When operating at 300 bps, the Model 3300 prints at 30 characters per second until a carriage return occurs. During the return period, the print head is disabled, a FIFO (First-In/First-Out) 40-character buffer fills, and when printing resumes the print head prints at 60 characters per second until the buffer has been emptied. In the 600 bps mode, 60 characters per second are printed at all times.

## INTERFACING

ROLM Model 3315 Terminal Printers can be used with ASCII devices using EIA RS-232C interfaces.

## CHARACTER SETS

The 96-character, upper- and lower-case English language set is standard with the Model 3315 Terminal Printers.

## TOP OF FORM CONTROL[**]

Standard on Model 3315 Terminal Printers, the Top of Form Control can be activated manually off-line, or may be operated under program control using the appropriate ASCII control code. Forms used are the pin-feed type with six holes per inch.

Multiple forms may be up to six parts in composition, the top sheet must be paper.

## VIEW MODE OPERATION

At the user's option, the View Mode can be manually selected. In this mode, the printing head automatically moves six spaces to the right, giving the user a clear view of previously printed text. If the print head is within six spaces of the right-hand margin, it automatically moves left. In both instances, when printing resumes, the print head moves back to its original position.

## SPECIFICATIONS

### GENERAL

| | |
|---|---|
| Speed: | 60 or 30 characters per second (switch-selectable) |
| Character Set: | 96 characters, upper and lower case |
| Character Style: | 5 x 7 dot matrix (0.083" x 0.107"), inclined 10" top right |
| Columns: | 132 |
| Printing Density: | 10 characters per inch (horizontal)<br>6 characters/inch (vertical) |
| Character Buffer: | 40 characters (first-in/first-out) |
| Keyboard: | Standard typewriter layout; three-level, capacitor switched, electronically debounced, n-key rollover (ordered by rising keystroke) |
| Interface: | EIA (RS-232C) |
| Carriage Return: | 500 ms for full 15-inch (38.1 cm) return |
| Line Feed: | 33 ms per line |
| Ribbon: | 0.5" (1.2 cm) x 80 yards (73.1 meters) mylar or 40 yards (36.5 meters) ink-impregnated fabric, multipass on each half of ribbon — auto reversing. |
| Control Codes: | 015 CR (Carriage Return). 012 LF (Line Feed). 014FF (Form Feed). 000 NULL and 077 DEL are unconditionally ignored. |
| AC Voltages: | 120V/60 Hz Standard. Others on request. |

### MECHANICAL

| | |
|---|---|
| Dimensions: | 33.5 in. (58 cm) height; 27.5 in. (69.8 cm) width; 21 in. (53.3 cm) depth |
| Weight: | 60 lb (27 kg) |

### ENVIRONMENTAL

| | |
|---|---|
| Temperature Range: | 10°C to +45°C operating; 5°C to 60°C storage |
| Relative Humidity Range: | To 90% operating; to 95% storage |
| Altitude Range: | To 10,000 ft (3,048 meters) operating; 50,000 ft (15,240 meters) storage |

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[*] 600 bps printing speed is available only when using a ROLM Model 3300 Combination I/O Interface or interfaces with Clear to Send logic on the interface transmitter.

[**] Top of Form Control is available when the ROLM 3315 Terminal Printer is used with a ROLM Model 3300 Combination I/O Interface (Clear to Send Mode). The Top of Form Control switch should be set to "0" when other interfaces are used (i.e., the 3310 Terminal Interface, the 3765 Asynchronous Interface, or the 3766 Asynchronous Multiplexer).

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# tape drive performance characteristics

**Tape speeds:**
45, 75 and 125 ips are standard.

**Transfer rates:**
NRZI: 5,000 to 100,000 bps at speeds from 25 to 125 ips.
Phase encode: 40,000 to 200,000 bps per track at speeds from 25 to 125 ips.

**Rewind speed:**
380 ips nominal

**Start/stop:**
5.5 milliseconds at 75 ips. Tolerances permit bilateral interchange of tapes with equipment compatible with ANSI/ECMA 9-track standards.

**Recording density:**
NRZI electronics: 200 and 800 cpi standard. Two position switch provides 200-800 cpi densities (Low/High).
Phase encode electronics: 1600 cpi

**Recording formats:**
NRZI: 9-track, ANSI/ECMA-compatible.
Phase encode: 9-track (1600 cpi) ANSI/ECMA-compatible.

**Tape width/thickness:**
½-inch width, 1.5 mil, 2400 feet (732 meters); for best performance use Ampex tapes 853, 854.

**Tape reels:**
10½" reels, with or without surround cartridges.

**Read/write gap to gap spacing:**
NRZI 9-track: 0.150 ±0.005 inch
Phase encode 9-track: 0.150 ±0.005 inch

**Speed variation:**
Instantaneous short-term speed variations are less than ±2% of the design center character rate.

**Linear speed variation:**
The average tape speed of any and all one-second intervals is within ±2% of the design center speed exclusive of start/stop transitions.

**Interface requirements:**
*(TTL, Data, and Control Lines):*

1. Inputs:
   a. True = 0 to +0.8 volt 16 ma max. sink current
   b. False = +2.0 to +5.5 volts Input equivalent circuit approximates to 25 Ohms ±10% returned to +2.6 volts ±10%.
2. Outputs:
   a. True = 0 to +0.5 volt maximum, sinking 40 ma; max. sinking capability: 60 ma.
   b. False = Substantially open circuit collector which may be returned to a potential not exceeding +5.5 volts. 10K ohm pull-up resistors returned to +5.0 volts ±10% are fitted internally to provide waveforms into open circuits for test purposes.

**Functional modes:**
1. Write-forward, Read-forward
2. Read only, forward
3. Read only, reverse

**Controls/Indicators:**
1. On-Line: pushbutton/indicator
2. Stop/reset: pushbutton
3. Forward: pushbutton
4. Reverse: pushbutton
5. Power On: pushbutton/indicator
6. File Protect: indicator only
7. Rewind/unload: pushbutton/indicator
8. High/low Density: (where applicable)

**Power input:**
1. Voltage: 45-75 ips *only* (100-125V) or 200-250V
2. Frequency: 48-63 Hz
3. Consumption: 2 KVA maximum

**Operating environment:**
1. Ambient temperature: +10°C to +40°C
2. Relative Humidity: 20% to 80%
3. Altitude: 0 ft. to 7,500 ft. (2286 meters)

**Dimensions:**
Height: 24 inches (60.96 cm)
For 125 ips model, add 8.75" (22.22 cm)
Width: 19 inches (48.26 cm)
Depth: 18 inches (45.72 cm)

**Available models:**
NRZI 9-track Read/Write including Read/Write electronics.

NRZI 9-track Read only including Read electronics.

Phase encode (1600 cpi) 9-track Read/Write including Read/Write electronics.

NRZI/Phase Encode (800/1600 cpi) 9-track Read/Write including Read/Write electronics.

Read only systems in dual (800/1600 cpi) density.

AMPEX
**Ampex Corporation**
**Data Products Division**
**401 Broadway**
**Redwood City, California 94063**
**(415) 367-4105**
**or phone toll free (800) 227-1981**

LITHO IN U.S.A.—D226A/1—2-75

# DE-800 series format control units performance characteristics

## ELECTRICAL SPECIFICATIONS

**DC Power Requirements:**
The external power requirements without the optional internal power supply are:
+5V DC ±0.2V @ 10 amps max. (this includes 3 amps for the optional interface board logic).

**AC Power Requirements:**
The external power requirements with the internal power supply are:
117V AC ± 12%, 47-63 Hz
@ 1.0 amps max.
230V AC ± 12%, 47-63 Hz
@ 0.5 amps max.
100V AC ± 10%, 50 Hz
220V AC ± 10%, 50 Hz

## MECHANICAL SPECIFICATIONS

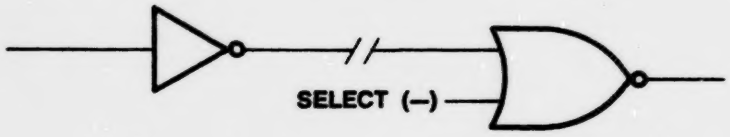
**Dimensions:**
Height: 5.25" (13.33 cm)
Width: 16.3" (41.40 cm)
Depth: 16" (40.64 cm)
Weight: 25 lbs. max (11.34 kg)
Mounting: RETMA rack mountable with slides as an option.

## ENVIRONMENTAL CHARACTERISTICS

**Temperature:**
Operating: 0° to +40°C
Non-operating: 0° to + 100°C

**Humidity:**
Operating: 10 to 90% (non-condensing)
Non-operating: 0 to 95% (non-condensing)

**Typical interface circuits for both the user and transport interfaces.**



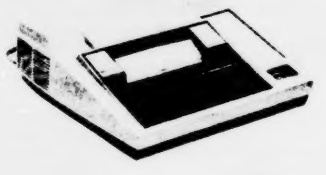
**TTL 7416 or Equivalent**

**TTL 7402 or Equivalent**

# SILENT 700*

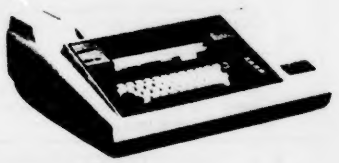
## electronic data terminals

# MODELS 732 AND 733



**RO** Model 732 RO with BAUDOT/CCITT code and Model 733 RO with USASCII code . . . RO models that can be easily upgraded to KSR models.

**ASR** Model 732 ASR with BAUDOT/CCITT code and Model 733 ASR with USASCII code . . . available with single or twin magnetic tape cassettes.



**KSR** Model 732 KSR with BAUDOT/CCITT code and Model 733 KSR with USASCII code . . . KSR models that can be easily upgraded to ASR models.

## FEATURES

### AUTOMATIC SEND-RECEIVE

ASR terminals combine 30 characters per second printing, keyboard operation and dual/single cassette storage. KSR models easily convert to ASR models.

### QUIET OPERATION

TI's unique solid state printhead eliminates the undesirable noise associated with impact printing, and coupled with magnetic tape cassettes, assures virtually silent operation.

### SOLID STATE RELIABILITY

TI MOS/LSI integrated circuits, solid state printhead, and reliable accurate, digital grade magnetic tape are keys to reliable, long-life operation.

### AUTOMATIC CR/LF

CR (carriage return) and LF (line feed) are automatically activated but not transmitted when the printhead reaches the right hand margin.

### STANDARD FEATURES

- Switch-selectable half or full duplex operation, single or double line spacing.
- 5 x 7 dot matrix with print contrast control
- EIA RS-232-C serial interface
- Single enclosure
- For ASR models, ANSI-compatible (Phillips-type) cassettes.

### ASR, KSR and RO MODELS

### MODEL 732

The Model 732 ASR, Model 732 KSR & Model 732 RO utilize Baudot/CCITT code with either US or UK character sets and have switch selectable speeds of 50, 75, and 100 Baud.

### MODEL 733

The Model 733 ASR, Model 733 KSR & Model 733 RO utilize USASCII code, switch selectable speeds of 10, 15, and 30 characters per second and switch selectable odd, even, or mark parity generation.

## OPTIONS/ACCESSORIES

### 732/733 COMMON

- **ANSWERBACK MEMORY:** Diode matrix memory transmits serially up to 21 Baudot or USASCII characters as a "station identification". The answerback memory is activated locally by the HERE IS key on ASR and KSR models. Model 733 maybe remotely enabled via receipt of the ENQ character. Model 732 is triggered remotely via serial receipt of the FIGURES character followed by the D character.
- **300 BAUD DC-CURRENT SERIAL INTERFACE:** Option converts standard internal EIA RS-232-C voltage level to current signals.
- Single Cassette (ASR units only)

### 733 ASR/KSR

- **ACOUSTIC COUPLER:** Integral "originate mode" acoustic coupler compatible with Bell System 103/113 data sets.
- **FULL ASCII KEYBOARD:** Standard Models 733 ASR and KSR will decode and print lower case data. Lower case information also may be received from the communications line and recorded and printed. The Full ASCII Keyboard option enables the user to generate lower case data from the keyboard for LOCAL recording or direct transmission. The option provides an UPPER CASE ONLY key which prevents the Full ASCII Keyboard from generating lower case data for those applications where the user does not desire lower case.

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## ADDITIONAL OPTIONS FOR MODEL 733
(● indicates Model 733 ASR/KSR/RO)
(◆ indicates Model 733 ASR only)

● **BUILT-IN 300 BAUD MODEM**: DS100 data sets provide Bell 100 series compatible frequency shift keying in a choice of operational modes. Terminals may be equiped with either the "Originate" or "Answer" mode configuration for half- and full-duplex operation over voice grade unconditioned lines. DS100 Modems are completely housed within the terminal enclosure and may access the Bell System DDD Network via a type CDT Data Access Arrangement. Private wire applications require either a 2- or 4-wire type 3002 line (no-conditioning).

| MODEL | MODE | TRANSMIT FREQUENCIES* | RECEIVE FREQUENCIES* |
|---|---|---|---|
| DS100 ATL | ORIGINATE | 1070 Hz Space<br>1270 Hz Mark | 2025 Hz Space<br>2225 Hz Mark |
| DS100 ATH | ANSWER | 2025 Hz Space<br>2225 Hz Mark | 1070 Hz Space<br>1270 Hz Mark |

| | |
|---|---|
| Transmitter output level | 0 to −15 dbm, adjustable |
| Receiver input level | 5 to −35 dbm, sensitivity |

Speed: Up to 30 characters/second, asynchronously.

*All frequencies ± 1%.

● **AUTOMATIC DEVICE CONTROL (ADC)**: Provides recognition of the ASCII DC1, DC2, DC3, DC4 (X-ON, TAPE, X-OFF, ~~TAPE~~) commands for automatic start/stop of the Record and Playback functions. Automatic Device Control Option (Part No. 971481-0001) provides recognition of the EOT character for controlled disconnect of calls in conjunction with the 300 Baud Automatic Answer option. (Early versions of this option [Part No. 960891] do not provide this feature.) DC 1-4 commands may be strapped (via pencil switch) to respond to local data, received data or transmitted data (see Remote Device Control). Unless specified, option is factory pre-set to respond in all modes. An operator accessable Master On-Off switch is provided to completely disable all Device Control functions.

◆ **AUTOMATIC SEARCH CONTROL (ASC)**: Option enables the Model 733 ASR to perform a "content oriented" search of data stored on tape. A character string identifier (from 1 to 16 non-control characters) is entered into a random access memory. Upon actuation of playback control, the search proceeds, without printout, at 3.0 blocks/sec (250 char/sec max) until a match is made. Control characters are transparent to the length of the character string identifier as well as the criteria for matching data on tape.

Search may be used in the LOCAL mode for locating data stored on tape. High speed tape to tape duplication during search allows increased editing flexibility permitting the operator to duplicate, "up to a point" without generation of hard copy. Remote search is possible in the ON-LINE mode with the addition of the Remote Device Control option. Remote Duplication is not possible.

| | LOCAL MODE | DUPLICATE MODE | REMOTE MODE |
|---|---|---|---|
| Request | ESC and $ keyed | ESC and $ keyed | ESC and $ received |
| Acknowledgement | Carriage Return/ Line Feed | Carriage Return/ Line Feed | None |
| Search Criteria | 1-16 character, identifier keyed | 1-16 character, identifier keyed | 1-16 character, identifier received |
| Initiation | Playback (Cont Start) On or DC1 | Record turned on, Playback (Cont Start) On or DC1 | DC1 received |
| End of Search Acknowledgement | Carriage Return/ Line Feed | Carriage Return/ Line Feed | See Status Character Remote Device Control |

◆ **1200 BAUD TRANSMISSION**: 120 character/sec communication rate is achieved in a tape to line to tape mode. Recorded data is sent to the communication line via an EIA RS-232-C interface for use with Bell 202 C, D, or R compatible data sets, as well as Vadic 3400 compatible data sets.

1200 Baud transmission optimizes the available bandwidth of voice grade lines and provides the user maximum point to point, half-duplex, communication speed. Inbound data is recorded at transmission speed for local 300 Baud printout after the call is completed. 10, 15, 30, and 120 character/sec operation is possible via dual external modems (Bell 103 compatible for up to 300 Baud and Bell 202 compatible or Vadic 3400 for 1200 Baud).

● **300 BAUD AUTOMATIC ANSWER**: Permits unattended terminals to automatically answer calls over the Bell System DDD Network. Automatic Answer (Part No. 960984-0001) connects to a Bell type CBS Data Access Arrangement and works in conjunction with the built-in DS100 ATH "Answer" mode modem. Part number 960984-0002 provides an EIA RS-232-C connector for attachment to a Bell 103A Data Set (with Auto-Answer option), or equivalent. Originate mode of 103 compatible modems is prohibited.

### FEATURES

- Automatic triggering of the Answerback Memory option (if installed) with an adjustable time delay of 0.6 msec to 10 sec. Automatic triggering requires either Remote Device Control or Automatic Device Control. Unless specified otherwise standard answerback memory delay is factory pre-set to 1.28 sec.
- Blinding of printer and record functions upon automatic disconnect.
- Long SPACE disconnect for termination of call in progress: a continuous logical zero of at least 1.28 seconds is required from the transmitting end.
- EOT disconnect terminates a call in progress via receipt of the End of Transmission character. Use of this feature requires that the terminal also have the Remote Device Control or (Part No. 971481-0001) Automatic Device Control options.

### INDICATORS

- TERMINAL READY: Light remains on as long as the Master On-Line Switch is on-line indicating the terminal will answer a call.
- RING INDICATOR: Flashes to signal incoming call; glows steadily after the call is answered and until carrier is detected.
- LINE READY: Illuminates when the terminal has answered the call, received carrier, and is ready to transmit or receive.

◆ **BINARY DATA FORMAT**: Enables the Model 733 ASR to record and playback 8 bits of data (binary). See page 6 for standard operation.

- RECORD: The TAPE FORMAT switch controls the format in which data is recorded on tape.
  - LINE Position: Tape recording of data blocks is initiated when either the USASCII carriage return character or the 86th character of each block is loaded into the record buffer. The 8th bit of each character is forced to a logic ZERO except that of the carriage return character, which is forced to a logic ONE.
  - CONTinuous Position: Tape recording of data blocks is initiated only when the 86th character of each block is loaded into the record buffer. All eight bits of the character are recorded, with the 8th bit retained as received.

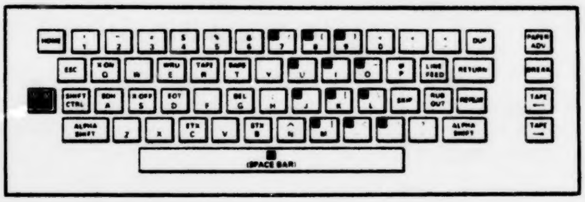
- PLAYBACK: Playback is controlled by the terminal ON-LINE/OFF switch regardless of whether Playback is set to LINE or LOCAL mode.
  - OFF Position: The playback locally operates in the standard manner: the next block of data recorded on tape is transmitted when a logic ONE is detected in the 8th bit of a character (indicating carriage return).
  - ON-LINE Position: The playback transmits all eight bits of the 86 characters per block on tape as recorded. All 86 characters are transmitted including data and nulls if data was recorded in LINE TAPE FORMAT regardless of the presence of a carriage return character.

NOTE: When the Model 733 ASR is operating with binary data:
- Automatic Device Control or Remote Device Control, if installed, should be switched OFF to prevent decoding control characters from binary data.
- Automatic Search Control will sense only the first 7 bits of each character.

◆ **FOOT PEDAL**: Allows an operator to externally control the PLAYBACK ON function of the Model 733 ASR, in the LOCAL mode. This option, a time saving device when used with format tapes, requires Remote Device Control.

## – OPTIONS CONTINUED –

- **EMBEDDED *CALCULATOR-TYPE* NUMERIC CLUSTER KEYBOARD OPTION**: Provides basic numerals and appropriate graphic and control characters configured similar to an adding machine or calculator to facilitate rapid entry of numerical data. The characters provided on the numeric keyboard option are offset in black on the keyboard layout to the right. The characters are generated upon depressing the numeric lock key.



- **REMOTE DEVICE CONTROL (RDC)**: Enables the Model 733 ASR to be controlled via data received from the communication line. Remote Device Control provides all single character commands common to the Automatic Device Control plus a number of dual character commands listed in the table below. The less obvious commands are described below the table. In addition, the option may be strapped to recognize the DC1 through DC4 commands when they are contained in local data, received data, or transmitted data via the lower table.

**Remote Device Control (Continued)**
Additional features of the Remote Device Control provide for automatic blinding of the printer function. Once a Data Link Escape (DLE) character is received, the printer is inhibited from printing the next character received. As well, the strappable automatic error detect feature causes automatic transmission of the CAN or cancel character when a playback error is detected. This feature is factory pre-set not to transmit and must be requested to be made operational.

### REMOTE DEVICE CONTROL COMMANDS[1]

| COMMAND | CODE | COMMAND | CODE |
|---|---|---|---|
| 1. PLAYBACK ON | DC1 | 11. CASSETTE 2 IN RECORD MODE | DLE6 |
| 2. RECORD ON | DC2 | 12. BLOCK FWD | DLE7 |
| 3. PLAYBACK OFF | DC3 | 13. BLOCK REV | DLE8 |
| 4. RECORD HALT | DC4 | 14. PRINTER ON | DLE9 |
| 5. AUTO-DISCONNECT PHONE LINE[2] | EOT | 15. PRINTER OFF | DLE0 |
| 6. REWIND CASSETTE 1 | DLE1 | 16. ADC ENABLE | DLE: |
| 7. REWIND CASSETTE 2 | DLE2 | 17. ADC DISABLE | DLE; |
| 8. LOAD CASSETTE 1 | DLE3 | 18. REQUEST STATUS | DLE< |
| 9. LOAD CASSETTE 2 | DLE4 | 19. 1200 BAUD PRINT LOCAL[3] | DLE> |
| 10. CASSETTE 1 IN RECORD MODE | DLE5 | 20. CANCEL REMOTE SEARCH[4] | DLE? |

NOTES: 1. Commands 5 through 20 are only effective on data received from the line. See DC Character Recognition Table. However, it is not possible to remotely change a LINE/LOCAL status from LOCAL to LINE or LINE to LOCAL.
2. When unit is equipped with 300 Baud Auto-Answer.
3. For use with future 1200 Baud developments.
4. When unit is equipped with Auto Search Control.

PRINTER OFF:
Command disables the printer from receiving line data. If this code sequence is received when the printer is in either the LINE or LOCAL mode the printer is disabled while it is in the LINE mode. This function is reset and reverts to the "Printer On" condition when the terminal is taken OFF LINE or when power is turned OFF and ON.

PRINTER ON:
Command restores printer functions, if in the LINE mode, after having been disabled.

CANCEL REMOTE SEARCH:
Command causes remote search in process to be cancelled.

ADC DISABLE:
Command disables the recognition of the DC 1-4 characters only on data received from the line. See DC Character Recognition Table. Extremely useful, in allowing the transmission of new format tapes (operator lead through) to the remote terminal from a central location. Reverts to the "ON" condition when the terminal is taken OFF LINE or power down is experienced.

ADC ENABLE:
Command restores recognition of the DC 1-4 characters after having been disabled.

REQUEST STATUS:
Command causes the terminal to transmit a single ASCII character indicating the status of the PLAYBACK, RECORD and PRINTER functions. See Status Character Response Table.

### STATUS CHARACTER RESPONSE

| BIT 1 | BIT 2 | BIT 3 | BIT 4 | BIT 5 | BIT 6 | BIT 7* |
|---|---|---|---|---|---|---|
| PLYBK | PLYBK | CAS 1 Cl. Leader | CAS 2 Cl. Leader | REC | PRINT | Search in Process |
| Rdy-1 | Error-1 | ON-1 | ON-1 | Rdy-1 | Rdy-1 | NO-1 |
| Not Rdy-0 | No Error-0 | OFF-0 | OFF-0 | Not Rdy-0 | Not Rdy-0 | YES-0 |

* Factory pre-set to constant logical 1 unless otherwise requested.

### DC CHARACTER RECOGNITION[1]

| PENCIL SWITCH (S2)[2] | LOCAL DATA[3] | | DATA RECEIVED FROM LINE[3] | | DATA TRANSMITTED TO LINE[3] |
|---|---|---|---|---|---|
| PLAYBACK ON (DC1) | ADC | RDC | ADC | RDC | Always Disabled |
| PLAYBACK OFF (DC3) | Rocker 3 | Rocker 3 | Rocker 2 | Rocker 4 | ADC: Rocker 1/RDC: Rocker 5 |
| RECORD ON (DC2) | ADC | RDC | ADC | RDC | Always Disabled |
| RECORD OFF (DC4) | Rocker 5 | Rocker 1 | Rocker 4 | Rocker 2 | |

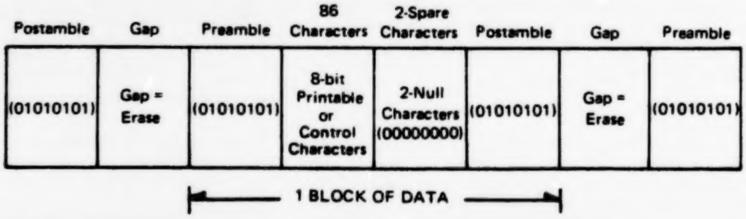
NOTES: 1. Table applies to both Remote Device Control and Automatic Device Control (Part No. 971481) options.
2. Factory pre-set to enable recognition on all five selections unless otherwise requested.
3. Switch Rockers in the ON position allow recognition of DC character(s) received from data sources.

# silent 700

**ELECTRONIC DATA TERMINAL**

## DETAILED SPECIFICATIONS FOR MODELS 732 AND 733 (Continued)

**5. Cassette Sub-System (ASR units)**


Postamble
Gap
Preamble
86 Characters
2-Spare Characters
Postamble
Gap
Preamble
(01010101)
Gap = Erase
(01010101)
8-bit Printable or Control Characters
2-Null Characters (00000000)
(01010101)
Gap = Erase
(01010101)
1 BLOCK OF DATA

A. Record Format: Incremental by block; preamble (8 bits, ANSI std.) 86 data or control characters, two characters (16 bits) for future flexibility, and postamble (8 bits ANSI std.).

B. Playback or Record: Model 733 – 10, 15 and 30 characters per second; with 1200 baud option, 120 characters per second. Model 732 – 6.67 cps, 10 cps or 13.33 cps. Tape duplication (dual cassette ASR units) without printing at an average of 250 characters per second.

C. In Line Format, block corresponds to a line of printout; in Continuous Format, block has 86 characters and may contain several printed lines. Line Format provides editing ease while Continuous Format achieves maximum packing density. Converting between formats achieved via tape duplication.

D. Interchangeability: Any tape recorded on any 732/733 ASR cassette operating within specifications may be read on any other 732/733 ASR of the same model operating within specifications.

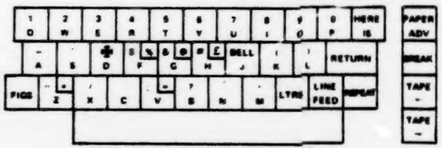
**6. Character Sets**

### Baudot/CCITT Character Set

MODEL 732 KSR/ASR/RO BAUDOT CODE AND CHARACTER SET

| BITS | | | | | LETTERS | FIGURES | FIGURES |
|---|---|---|---|---|---|---|---|
| $b_5$ | $b_4$ | $b_3$ | $b_2$ | $b_1$ | US & UK | US | UK |
| 0 | 0 | 0 | 0 | 0 | IDLE | IDLE | IDLE |
| 0 | 0 | 0 | 0 | 1 | E | 3 | 3 |
| 0 | 0 | 0 | 1 | 0 | LINE FEED | LINE FEED | LINE FEED |
| 0 | 0 | 0 | 1 | 1 | A | - | - |
| 0 | 0 | 1 | 0 | 0 | SPACE | SPACE | SPACE |
| 0 | 0 | 1 | 0 | 1 | S | ! | ! |
| 0 | 0 | 1 | 1 | 0 | I | 8 | 8 |
| 0 | 0 | 1 | 1 | 1 | U | 7 | 7 |
| 0 | 1 | 0 | 0 | 0 | CAR RET | CAR RET | CAR RET |
| 0 | 1 | 0 | 0 | 1 | D | ✚ | ✚ |
| 0 | 1 | 0 | 1 | 0 | R | 4 | 4 |
| 0 | 1 | 0 | 1 | 1 | J | BELL | BELL |
| 0 | 1 | 1 | 0 | 0 | N | , | , |
| 0 | 1 | 1 | 0 | 1 | F | $ | % |
| 0 | 1 | 1 | 1 | 0 | C | | |
| 0 | 1 | 1 | 1 | 1 | K | ( | ( |
| 1 | 0 | 0 | 0 | 0 | T | 5 | 5 |
| 1 | 0 | 0 | 0 | 1 | Z | " | + |
| 1 | 0 | 0 | 1 | 0 | L | ) | ) |
| 1 | 0 | 0 | 1 | 1 | W | 2 | 2 |
| 1 | 0 | 1 | 0 | 0 | H | # | £ |
| 1 | 0 | 1 | 0 | 1 | Y | 6 | 6 |
| 1 | 0 | 1 | 1 | 0 | P | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 | Q | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | O | 9 | 9 |
| 1 | 1 | 0 | 0 | 1 | B | ? | ? |
| 1 | 1 | 0 | 1 | 0 | G | & | @ |
| 1 | 1 | 0 | 1 | 1 | FIGS | FIGS | FIGS |
| 1 | 1 | 1 | 0 | 0 | M | . | . |
| 1 | 1 | 1 | 0 | 1 | X | / | / |
| 1 | 1 | 1 | 1 | 0 | V | ; | = |
| 1 | 1 | 1 | 1 | 1 | LTRS | LTRS | LTRS |

▨ NON-PRINTABLE CHARACTERS


HERE IS
PAPER ADV
BELL
RETURN
BREAK
FIGS
LTRS
LINE FEED
REPEAT
TAPE
TAPE

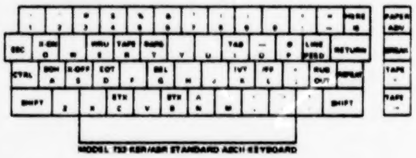
MODEL 732 KSR/ASR BAUDOT KEYBOARD

### USASCII Character Set

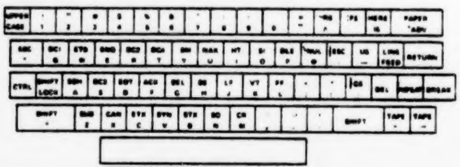
MODEL 733 KSR/ASR/RO USASCII CODE SYSTEM (ANSI X3.4-1968)

| $b_7$ $b_6$ $b_5$ | | | | | 0 0 0 | 0 0 1 | 0 1 0 | 0 1 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $b_4$ | $b_3$ | $b_2$ | $b_1$ | COLUMN / ROW | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | NUL | DLE | SP | 0 | @ | P | ` | p |
| 0 | 0 | 0 | 1 | 1 | SOH | DC1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | STX | DC2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | ETX | DC3 | # | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | EOT | DC4 | $ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | ENQ | NAK | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | ACK | SYN | & | 6 | F | V | f | v |
| 0 | 1 | 1 | 1 | 7 | BEL | ETB | ' | 7 | G | W | g | w |
| 1 | 0 | 0 | 0 | 8 | BS | CAN | ( | 8 | H | X | h | x |
| 1 | 0 | 0 | 1 | 9 | HT | EM | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10 | LF | SUB | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11 | VT | ESC | + | ; | K | [ | k | { |
| 1 | 1 | 0 | 0 | 12 | FF | FS | , | < | L | \ | l | ¦ |
| 1 | 1 | 0 | 1 | 13 | CR | GS | - | = | M | ] | m | } |
| 1 | 1 | 1 | 0 | 14 | SO | RS | . | > | N | ^ | n | ~ |
| 1 | 1 | 1 | 1 | 15 | SI | US | / | ? | O | _ | o | del |

▨ NON-PRINTABLE CHARACTERS


HERE IS
PAPER ADV
ESC
TAB
LINE FEED
RETURN
BREAK
CTRL
SHIFT
SHIFT
TAPE
TAPE

MODEL 733 KSR/ASR STANDARD ASCII KEYBOARD


HERE IS
PAPER ADV
ESC
LINE FEED
RETURN
CTRL
DEL
REPEAT
BREAK
SHIFT
SHIFT
TAPE
TAPE

MODEL 733 KSR/ASR FULL ASCII KEYBOARD

Texas Instruments reserves the right to make changes in the design at any time to supply the best product possible.

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TEXAS INSTRUMENTS
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M51

## MODELS 732 AND 733 GENERAL SPECIFICATIONS

1. Printer
   - A. Friction-feed platen
   - B. Line length: 8 inches (80 characters/line, 10 characters/inch).
   - C. Line Spacing: Switch-selectable 3 or 6 lines/inch.
   - D. Complete visibility of printed data, including the line being printed and the character just printed.
   - E. Enclosure contains space for printing paper: 8 1/2 in. wide x 300 ft. long x 3 5/8 in. diameter roll.
   - F. Character font: standard models print characters from 5 x 7, 35-dot matrix printhead, character size 0.105 in. x 0.080 in. On standard Model 733, lower-case received data is printed from 5 x 5 matrix, character size 0.0715 in. x 0.080 in.; with optional full USASCII keyboard, lower-case alphabet is also generated.
   - G. Carriage return/line feed (CR/LF) automatic at column 81, no code is transmitted. Maximum time for: (1) CR is 195 ms from any column, (2) LF (single space) is 33 ms, and (3) LF (double space) is 67 ms.

2. Printing Paper
   TI thermographic printing paper, No. 213714 (white).

3. Paper Out Indication
   Last 10 ft. of TI thermographic printing paper roll is color coded.

4. Keyboard
   "Two-key roll over" electronically prevents transmission when two keys are depressed simultaneously.

5. Cassettes (ASR units only)
   - A. Recording method: phase-encoding at 800 bpi, 86 character blocks.
   - B. Bit error rate: 1 in $10^6$ (maximum), 1 in $10^7$ (typical).
   - C. Storage medium: ANSI-compatible (Phillips-type) cassettes containing 300 feet digital grade magnetic tape.
   - D. Storage: 155,000 characters per track or 310,000 characters per cassette (maximum).
   - E. Off-line playback or record at 30 characters per second; tape duplication without printing at 250 characters per second. On-line playback or record for Model 732 at 6.67, 10, and 13.33 cps; for Model 733 at 10, 15 and 30 cps.
   - F. Transfer Rate: 6400 bits/sec.
   - G. Tape Speed: Read/Write 8 in./sec.; rewind time, 60 seconds (maximum).
   - H. Sensors: EOT, BOT, cassette in place, write tab, cassette door closed.

6. Physical
   - A. Power requirements: 115/230 volts RMS + 10% − 15%, 50/60-Hz, 200 VA maximum via a 6 foot 3 wire cable with type "U" grounded 3-prong connector.
   - B. Ambient temperature: Operating, 10°C to 35°C. Storage, −30°C to 70°C, not including paper or magnetic cassettes. Paper, −30°C to 40°C.
   - C. Shock: Operating 0g. Storage and handling, 10g for 11 msec (in shipping container.)
   - D. Vibration: 10 to 60 cps, 0.5 g.
   - E. Humidity: Operating, equipment only 10% to 90%. Storage, 10% to 95%. (Non-condensing)
   - F. Terminal is self-contained. Dimensions for KSR and RO units are 21.2" wide x 19.5" deep x 7.2" high. Dimensions for ASR units are 21.2" wide x 19.5" deep x 14.6" high.
   - G. Weight (excluding options): KSR and RO units, 38 lbs maximum. ASR units, 55 lbs. maximum.

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## DATA INTERFACE SPECIFICATIONS

<table>
<tr><td></td><td></td><td><b>TERMINAL PINS</b></td><td><b>MODEM PINS</b></td><td><b>FUNCTION</b></td></tr>
<tr><td rowspan="9"><b>EIA RS-232-C Serial Data Interface</b></td><td rowspan="9">A. Standard EIA RS-232-C interface cables have 6 ft. minimum length terminating with a 25-pin male connector.</td><td>A</td><td>1</td><td>Protective Ground</td></tr>
<tr><td>H</td><td>2</td><td>Transmitted Data</td></tr>
<tr><td>10</td><td>3</td><td>Received Data</td></tr>
<tr><td>F</td><td>4</td><td>Request to Send[1]</td></tr>
<tr><td>8</td><td>5</td><td>Clear to Send[2]</td></tr>
<tr><td>9</td><td>6</td><td>Data Set Ready[3]</td></tr>
<tr><td>7</td><td>7</td><td>Signal Ground</td></tr>
<tr><td>K</td><td>8</td><td>Data Carrier Detect[4]</td></tr>
<tr><td>6</td><td>20</td><td>Data Terminal Ready[1]</td></tr>
<tr><td></td><td></td><td colspan="3">1. Held to EIA ON (>+3 V) when terminal is on line.<br>2. Held to EIA ON by modem to allow transmission – required for transmission.<br>3. Held to EIA ON by modem when modem is operative – required for operation.<br>4. Held to EIA ON by modem during receipt of carrier – required for data reception.</td></tr>
<tr><td></td><td rowspan="2">300 Baud Automatic Answer (use with external Modem)</td><td>E</td><td>20</td><td>Data Terminal Ready[5]</td></tr>
<tr><td></td><td>D</td><td>22</td><td>Ring Indicator[6]</td></tr>
<tr><td></td><td></td><td colspan="3">5. See above except signal is switched EIA ON to answer incoming call and EIA OFF to disconnect.<br>6. Normally EIA OFF, signal comes high with ring of incomming call.</td></tr>
<tr><td></td><td>1200 Baud</td><td>C</td><td>4</td><td>Request to Send[7]</td></tr>
<tr><td></td><td></td><td colspan="3">7. Held to EIA ON when terminal is ready to transmit – playback ON or character keyed. Receive mode has priority over transmit mode – terminal may bring RTS signal high after non-receipt of data for at least one character time.</td></tr>
<tr><td></td><td></td><td><b>TERMINAL PIN</b></td><td><b>WIRE COLOR</b></td><td><b>FUNCTION</b></td></tr>
<tr><td rowspan="4"><b>300 Baud dc-Current Loop Serial Interface</b></td><td rowspan="4">A. Nominal operating current is field settable to either 60 ma or 20 ma.<br>B. Less than 5 V (transmit) and 7 V (receive) drop across contacts while marking.<br>C. A 6 ft. cable with 4 spade lugs is supplied with this interface option.</td><td>4</td><td>White</td><td>Positive Receiver Input Loop</td></tr>
<tr><td>D</td><td>Green</td><td>Receiver Input Loop</td></tr>
<tr><td>5</td><td>Black</td><td>Transmitter Outout Loop</td></tr>
<tr><td>E</td><td>Red</td><td>Transmitter Output Loop</td></tr>
<tr><td></td><td></td><td><b>TRANSMIT</b></td><td><b>RECEIVE</b></td><td><b>DESCRIPTION</b></td></tr>
<tr><td rowspan="3"><b>300 Baud Integral Acoustic Coupler</b></td><td rowspan="3">A. Compatible with Bell 103/113 data sets<br>B. Originate mode<br>C. Frequency shift keying</td><td>Mark: 1270 ± 10 Hz</td><td>Mark: 2225 ± 10 Hz</td><td>Frequencies</td></tr>
<tr><td>Space: 1070 ± 10 Hz</td><td>Space: 2025 ± 10 Hz</td><td></td></tr>
<tr><td>Equivalent to −20 to −5 dBm</td><td>Equivalent to −35 dBm</td><td>Input/Output Levels</td></tr>
<tr><td></td><td></td><td><b>TERMINAL PIN</b></td><td><b>WIRE COLOR</b></td><td><b>FUNCTION</b></td></tr>
<tr><td rowspan="2"><b>300 Baud Built-in Modem</b></td><td rowspan="2">A. Conforms to Bell Data Access Arrangement CDT.<br>B. Originate or answer mode available.<br>C. A 6 ft. cable with 2 spade lugs is supplied with the built-in modem option.</td><td>C</td><td>Red</td><td>Data Tip (DT)</td></tr>
<tr><td>3</td><td>Black</td><td>Data Ring (DR)</td></tr>
<tr><td></td><td></td><td><b>TERMINAL PIN</b></td><td><b>WIRE COLOR</b></td><td><b>FUNCTION</b></td></tr>
<tr><td rowspan="7"><b>300 Baud Automatic Answer (use with internal Modem)</b></td><td rowspan="7">A. Conforms to Bell Data Access Arrangement CBS.<br>B. Use with Answer mode built-in modem.<br>C. A 6 ft. cable with 7 spade lugs is supplied in place of manual modem cable above.</td><td>7</td><td>Black</td><td>Signal Ground (SG)</td></tr>
<tr><td>E</td><td>Red</td><td>Off Hook (OH)</td></tr>
<tr><td>D</td><td>Green</td><td>Ring Indicator (RI)</td></tr>
<tr><td>5</td><td>White</td><td>Coupler Cut Through (CCT)</td></tr>
<tr><td>6</td><td>Brown</td><td>Data Transmission (DA)</td></tr>
<tr><td>C</td><td>Orange</td><td>Data Tip (DT)</td></tr>
<tr><td>3</td><td>Yellow</td><td>Data Ring (DR)</td></tr>
</table>

## DETAILED SPECIFICATIONS FOR MODELS 732 AND 733

| | | |
|---|---|---|
| **1. Keyboard and Transmission Code** | MODEL 732: Baudot, 5 level, 7.5 bits per character including one start and one and a half stop bits.<br>The printer character set includes letters and figures – U.S. or letters and figures – UK; selection is a strappable feature. Each has 51 printable characters. | MODEL 733: USASCII, 7-level, 11 bits per character including parity, start, and two stop bits at 10 characters/sec speed; 10 bits per character with one stop bit at higher speeds.<br>A. Standard ASCII keyboard has 68 printable characters and 33 control characters.<br>B. Full ASCII keyboard has 95 printable characters and 33 control characters. UPPER CASE KEY causes unshifted, alphabetic characters to generate upper case codes. |
| **2. Data Format** | MODEL 732: Half- or full-duplex; asynchronous, serial-by-bit, serial-by-character. Within the terminal, eight bits include a 5-bit Baudot character code, an extra bit which is used as a block marker in the ASR unit, and two spare bits. | MODEL 733: Half- or full-duplex; asynchronous serial-by-bit, serial-by-character. Within the terminal, eight bits include a 7-bit ASCII character code plus an extra bit which is used as a block marker in the ASR unit. |
| **3. Operator Controls** | **RO/KSR/ASR** | **ASR** |
| **A. Terminal** | Power: On/Off<br>Speed: Lo/Med/Hi<br>Transmission Mode: Half/Full Duplex<br>*Parity Select: Odd/Even/Mark<br>†Terminal Status: On-line/Off | *Speed Status: Lo/Hi (with 1200 Baud Option) |
| **B. Printer** | Print Contrast: Light-Dark<br>Line Space: Single/Double<br>††Paper Advance | Status: Line/Off/Local |
| **C. Cassette 1/ Cassette 2** | | Operating Mode: Record/Playback<br>Tape: Rewind/Stop and Load-Fast Fwd/Stop |
| **D. Record Control** | | Status: Line/Off/Local and On/Off<br>Tape: Erase/Print<br>Tape Format: Line/Continuous |
| **E. Playback Control** | | Status: Line/Off/Local<br>Tape: Continuous Start/Stop, Block Fwd/Rev and Character Fwd |
| **F. Keyboard** | †REPEAT key<br>†PAPER ADVANCE key<br>†LINE FEED key<br>†HERE IS key<br>†BREAK key<br>†CARRIAGE RETURN key<br>**FIGS key<br>**LTRS key<br>TAP$\underset{\leftarrow}{\text{E}}$ key<br>TAP$\underset{\rightarrow}{\text{E}}$ key | Status: Line/Off/Local |
| **4. Condition Indicators** | **RO/KSR/ASR** | **ASR** |
| **A. Terminal** | "Power on" light | |
| **B. Cassette 1/ Cassette 2** | | "READY" light<br>"END" light<br>"RECORD" light<br>"PLAYBACK" light |
| **C. Record Control** | | "RECORD ON" light<br>"CHARACTER" display |
| **D. Playback Control** | | "PLAYBACK ON" light<br>"PLAYBACK ERROR" light |

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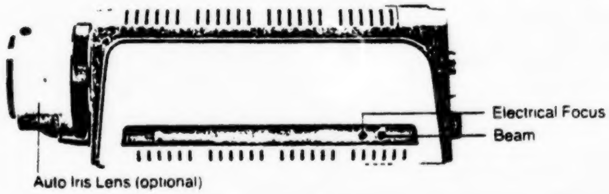
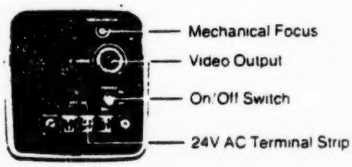
*Model 733 only
**Model 732 only
†ASR/KSR only
††RO only

**WV-1050/1054**

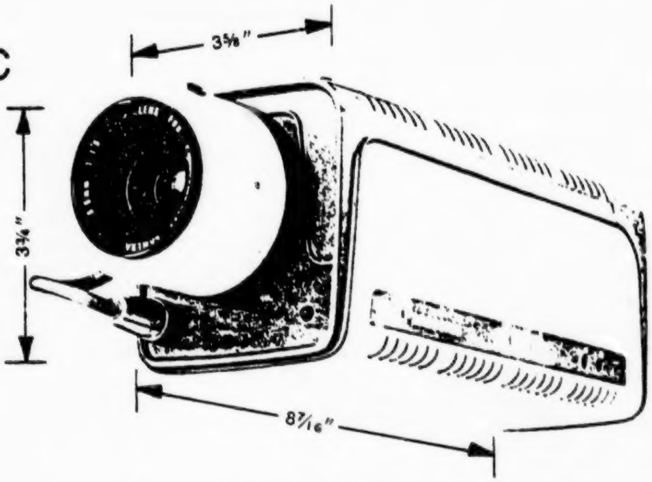

Electrical Focus
Beam
Auto Iris Lens (optional)

**24V AC CAMERA WV-1004/1054**


Mechanical Focus
Video Output
On/Off Switch
24V AC Terminal Strip

# NEWVICON

## WV-1050 120V AC
## WV-1054 24V AC



Shown with optional Auto Iris Lens

## PANASONIC CCTV CAMERAS
## WV-1000 SERIES

The Panasonic WV - 1000 series is a complete line of closed circuit television cameras especially designed for security. Twelve models offer a choice of sensitivity, with standard vidicon or supersensitive Newvicon™ pick-up tubes; a choice of synchronization, with internal or internal/external sync models; and a choice of power requirement, with standard line voltage or low voltage models. A product of our vast experience in CCTV design, the WV - 1000 series cameras are a logical choice for dependable closed circuit television.

### CCTV — the Visible Deterrent

The WV-1000 series cameras are attractively designed and stand out from their surroundings. A front-mounted pilot light shows the camera is on. To take full advantage of the deterrent effect of closed circuit television, dummy cameras are a low-cost way to supplement the system. Dummy model WV-1000D is identical in appearance to its working counterpart, WV-1000.

### [illegible]

CCTV cameras can also be hidden away or housed in our optional camera housings which are less conspicuous. And with our Newvicon models, nonvisible infrared illumination can be used — the room will appear dark to the intruder, but the camera will be able to spot him.

### High Quality TV Pictures

Panasonic CCTV cameras use ⅔" separate mesh vidicon and Newvicon tubes to produce sharp, detailed pictures. White clipper and black clamp circuits assure maximum detail without excessive contrast. A mechanical focus adjustment moves the camera tube forward or backward to accommodate slight variations in the back focus distance often encountered in long and short focal length lenses. And some models, as shown in the chart below, have a normal/high sensitivity switch for operation in lower light levels.

| Type | Models | Horizontal Resolution | S/N |
|---|---|---|---|
| Basic | WV-1000 1004 | 550 lines | 42 dB |
| | WV 1050 1054 | 600 lines* | |
| Normal High Sensitivity | WV 1100 1104<br>WV-1300 1304 | NOR 600 lines<br>HI 450 lines | NOR 43dB |
| | WV-1150 1154,<br>WV-1350 1354 | NOR: 500 lines*<br>HI: 400 lines* | HI 40dB |

* ····· With KF-series lens.
Resolution higher with SZ-series lens.

### Vidicon Models

The yellow front panel identifies our vidico cameras. Minimum illumination for the basic model WV-1000 is just one footcandle. Models WV-1100 and WV-1300 have a normal/high sensitivity switch for operatio in as little as 0.5 footcandle. Automatic ligh compensation is accomplished by automatic adjustment of the target voltage; manual adjustment is also possible on models WV-1100 and WV-1300. A norma lens (16mm, *f*/1.6) is included with each vidicon camera; other C-mount lenses ca also be used.

**Vidicon Models**

| Models | Sensitivity |
|---|---|
| WV-1000 1004 | 1 footcandle |
| WV-1100 1104,<br>WV-1300 1304 | NOR: 2 footcandle<br>HI: 0.5 footcandle |

### Newvicon Models

The orange front panel identifies our Newvicon cameras. Far more sensitive than standard vidicons, the Newvicon tube is also sensitive to a broad spectrum of ligh including invisible light in the near infrare range. Minimum incandescent illumination for basic model WV-1050 is only 0.05 foo candle with *f*/1.6 lens. The Newvicon tube features very low dark current, no burn-in and no blooming of high brightness deta Unlike the silicon target vidicon, the Newvicon gives high sensitivity without a sacrifice in resolution. Newvicon gamma correction is fixed at 0.7, to result in a TV picture with realistic rendition of scene brightness gradations. Automatic light control is accomplished by use of optional auto-iris lenses.

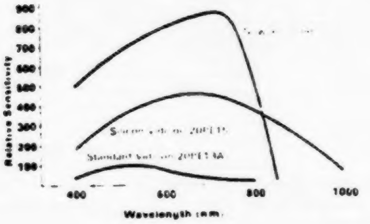
**Newvicon Models**

| Models | Sensitivity |
|---|---|
| WV-1050 1054 | 0.05 footcandle |
| WV-1150 1154,<br>WV-1350 1354 | NOR 0.06 footcandle<br>HI: 0.03 footcandle |

**Relative sensitivity for various kinds of lamps**

| Tube Type<br>Lamp | Newvicon S4075 | Silicon Vidicon 20PE15 | Standard Vidicon 20PE13A |
|---|---|---|---|
| Incandescent | 9.7 | 5.4 | 1.0 |
| Fluorescent | 5.5 | 2.5 | 0.47 |
| Mercury Vapor | 4.2 | 2.2 | 0.55 |
| Sodium Vapor | 3.5 | 1.7 | 0.58 |
| Infrared | 13.8 | 10.5 | 0.60 |

**Spectral sensitivity**



### Sync Modes

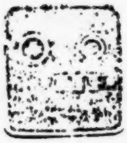
The blue stripe identifies our economical internal random interlace sync models. Internal random/external (silver stripe) and internal 2:1 interlace/external (gold stripe) sync models are also available. The internal/external cameras feature automatic selection of the sync mode: if the external sync source is removed, the camera automatically switches to internal sync. External sync is fed to the camera through a 10-pin connector at the rear.

| Sync Mode | Models |
|---|---|
| Internal Random | WV-1000, WV-1004, WV-1050, WV-1054 |
| Internal Random/ External | WV-1100, WV-1104, WV-1150, WV-1154 |
| Internal 2:1/ External | WV-1300, WV-1304, WV-1350, WV-1354 |

### [illegible]

Standard line voltage models are designed to plug into grounded wall outlets. Low voltage (24V AC) versions of each camera are also available. The advantage of the low voltage power requirement is realized during installation. Typically, closed circuit TV cameras are installed high up on ceilings, walls or poles. These areas afford little or no access to standard AC outlets. Thus the cost of installing conventional CCTV cameras must often include additional electrical outlets, with new wiring and conduit; this can be prohibitive in large installations. With low voltage models, a three wire low voltage power cord is wired at the same time as the coaxial video output cables. A central step-down transformer* supplies power to all cameras in the system and has the added advantage of enabling all cameras to be turned on and off from one location.

| Power | Models |
|---|---|
| Standard line voltage, 120V AC | WV-1000, WV-1050, WV-1100, WV-1150, WV-1300, WV-1350 |
| Low voltage, 24V AC | WV-1004, WV-1054, WV-1104, WV-1154, WV-1304, WV-1354 |

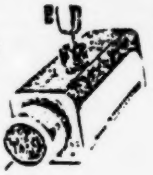


*Rear View of 24V AC Camera*

### Mounting

The WV-1000 series cameras are design for the most popular type of mounting — from the ceiling. The ¼" x 20 threaded socket is at the top of the camera. This permits the use of simpler, less expensive ceiling mounting brackets, such as the WV-7010 (optional). If the camera must b mounted on a tripod, the deflection can be reversed by changing a socket internally

*Camera Shown With WV-7010 Ceiling Mount (Optional)*



### Simple, Dependable Operation

Security equipment must be on guard day-in and day-out. Reliability is a must. Dependable solid state circuitry, includin IC's, FET's and silicon transistors, assur maintenance-free operation. The rugged die cast chassis assures stability of inter alignment. Once the camera is set up, tur ing it on and off is all that is required for day-to-day security operations.

### Panasonic's Reputation for Quality

The Panasonic WV-1000 series camera represent the latest generation in CCTV technology, incorporating all the refinements of more than a decade's experien in closed circuit television. As one of the world's largest electronics manufacturer our parent company makes every vital component in our cameras, including vidicon and Newvicon tubes, integrated circuits, transistors, and many other electronic components. This enables our factories to control the quality of our produ every step along the way. Every camera that comes off our assembly line is thoroughly tested. Should service ever b required, every Panasonic CCTV produc is backed up by a nation-wide network o authorized dealers and Factory Servicenters.

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*The 120V-to-24V step-down transformer should be obtained locally.*

## PERFORMANCE DATA & SPECIFICATIONS

| | **Vidicon Cameras** | **Newvicon Cameras** |
|---|---|---|
| **Power Source:** | WV-1000, WV-1100, WV-1300: 120V AC, 60 Hz<br>WV-1004, WV-1104, WV-1304: 24V AC, 60 Hz | WV-1050, WV-1150, WV-1350: 120V AC, 60 Hz<br>WV-1054, WV-1154, WV-1354: 24V AC, 60 Hz |
| **Power Consumption:** | WV-1000: 10 Watts<br>WV-1004, WV-1100, WV-1300: 11 Watts<br>WV-1104, WV-1304: 12 Watts | WV-1050: 11 Watts<br>WV-1054, WV-1150, WV-1350: 12 Watts<br>WV-1154, WV-1354: 13 Watts |
| **Pick-up Tube:** | 2/3" magnetic focusing, magnetic deflection,<br>separate mesh vidicon 20PE13A | 2/3" magnetic focusing, magnetic deflection,<br>separate mesh Newvicon S4075 |
| **Scanning Standard:** | 525 lines/60 fields/30 frames | 525 lines/60 fields/30 frames |
| **Sync:** | WV-1000, WV-1004: Internal line locked random interlace<br>WV-1100, WV-1104: Internal line locked random or external interlace<br>WV-1300, WV-1304: Internal 2:1 or external interlace | WV-1050, WV-1054: Internal line locked random interlace<br>WV-1150, WV-1154: Internal line locked random or external interlace<br>WV-1350, WV-1354: Internal 2:1 or external interlace |
| **Sensitivity Selector:** | WV-1000, WV-1004: No<br>WV-1100, WV-1104, WV-1300, WV-1304: Yes (NOR/HI) | WV-1050, WV-1054: No<br>WV-1150, WV-1154, WV-1350, WV-1354: Yes (NOR/HI) |
| **Minimum Required Illumination: (incandescent, with f/1.6 lens)** | WV-1000, WV-1004: 1 footcandle<br>WV-1100, WV-1104, WV-1300, WV-1304:<br>NOR: 2 footcandles<br>HI: 0.5 footcandle | WV-1050, WV-1054: 0.05 footcandle<br>WV-1150, WV-1154, WV-1350, WV-1354:<br>NOR: 0.06 footcandle<br>HI: 0.03 footcandle |
| **Horizontal Resolution: (at center)** | WV-1000, WV-1004: 550 lines<br>WV-1100, WV-1104, WV-1300, WV-1304:<br>NOR: 600 lines HI: 450 lines | WV-1050, WV-1054: 500 lines<br>WV-1150, WV-1154, WV-1350, WV-1354:<br>NOR: 500 lines HI: 400 lines |
| **S/N Ratio:** | WV-1000, WV-1004: More than 42 dB<br>WV-1100, WV-1104, WV-1300, WV-1304:<br>NOR: More than 43 dB HI: More than 40 dB | WV-1050, WV-1054: More than 42 dB<br>WV-1150, WV-1154, WV-1350, WV-1354<br>NOR: More than 43 dB HI: More than 40dB |
| **Mechanical Focus:** | Yes | Yes |
| **White Suppressor:** | Yes | Yes |
| **Gamma Correction:** | No | 0.7 (fixed) |
| **Automatic Light Compensation:** | 10,000:1 | 50,000:1 with Panasonic auto iris lens |
| **Video Output:** | WV-1000, WV-1004: 1.0 Vp-p composite,<br>75 ohms, UHF connector<br>WV-1100, WV-1104, WV-1300, WV-1304:<br>1.0 Vp-p composite, 75 ohms, UHF and<br>10-pin connectors | WV-1050, WV-1054: 1.0 Vp-p composite,<br>75 ohms, UHF connector<br>WV-1150, WV-1154, WV-1350, WV-1354<br>1.0 Vp-p composite, 75 ohms, UHF and<br>10-pin connectors |
| **Ambient Operating Temperature:** | 14°F to 122°F | WV-1050, WV-1054: 14°F to 122°F<br>WV-1150, WV-1154, WV-1350, WV-1354:<br>NOR: 14°F to 122°F<br>HI: 14°F to 104°F |
| **Ambient Operating Humidity:** | Less than 90% | Less than 90% |
| **Lens:** | 16mm, f/1.6 C-mount lens included | Requires auto iris lens (not included) |
| **Solid State Devices:** | WV-1000, WV-1004: 33 · 8 IC's<br>WV-1100, WV-1104: 36 · 8 IC's<br>WV-1300, WV-1304: 35 · 9 IC's | WV-1050, WV-1054: 33 · 7 IC's<br>WV-1150, WV-1154: 36 · 7 IC's<br>WV-1350, WV-1354: 35 · 8 IC's |
| **Dimensions:** | WV-1000, WV-1004: 3⅝" (92mm) W x<br>3¾" (96mm) H x 8⁷⁄₁₆" (214mm) D<br>WV-1100, WV-1104, WV-1300, WV-1304<br>3⅝" (92mm) W x 3¾" (95mm) H x 9¼" (234mm) D | WV-1050, WV-1054: 3⅝" (92mm) W x<br>3¾" (96mm) H x 8⁷⁄₁₆" (214mm) D<br>WV-1150, WV-1154, WV-1350, WV-1354<br>3⅝" (92mm) W x 3¾" (96mm) H x 9¼" (234mm) D |
| **Weight (less lens):** | WV-1000, WV-1004: Approx. 3½ lbs. (1.6 kg)<br>WV-1100, WV-1104, WV-1300, WV-1304:<br>Approx. 4 lbs. (1.8 kg) | WV-1050, WV-1054 : Approx. 3½ lbs. (1.6 kg)<br>WV-1150, WV-1154, WV-1350, WV-1354:<br>Approx. 4 lbs. (1.8 kg) |
| **Standard Accessories:** | 16mm, f/1.6 C-mount lens: 1 pc | Lens cleaning paper: 1 set |
| **Optional Accessories:** | **C-mount lenses:**<br>MN-815 8.5mm, f/1.5 wide angle lens<br>MN-518 50mm, f/1.8 telephoto lens | **Auto iris lenses:**<br>KF-85A 8.5mm, f/1.5 wide angle lens<br>KF-16A 16mm f/1.6 normal lens<br>KF-25A 25mm, f/1.4 telephoto lens<br>KF-50A 50mm, f/1.8 telephoto lens<br>SZ-95RND KT 16.5mm-95mm, f/2.0 motorized zoom lens with remote control unit |
| | **Camera cables:**<br>10G-25 (25 ft.), 10G-50 (50 ft.), 10G-100 (100 ft.) | **Camera cables:**<br>10G-25 (25 ft.), 10G-50 (50 ft.), 10G-100 (100 ft.) |
| | **Extension camera cables:**<br>10H-25 (25 ft.), 10H-50 (50 ft.), 10H-100 (100 ft.) | **Extension camera cables:**<br>10H-25 (25 ft.), 10H-50 (50 ft.), 10H-100 (100 ft.) |
| | **Video extension cables:**<br>VEC-25 (25 ft.), VEC-50 (50 ft.), VEC-100 (100 ft.) | **Video extension cables:**<br>VEC-25 (25 ft.), VEC-50. (50 ft.), VEC-100 (100 ft.) |

---

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**Panasonic** Video Systems: Video Recorders • Cameras • Monitors • Production Accessories

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M57

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Canon

# J6×12REA(DC)

**6X**
ZOOM RATIO

12.5–75mm 1:1.8 With Attenuator

CANON TV ZOOM LENS
Canon
J6 x 12REA (DC) 12.5–75mm 1:1.8
CANON INC. LENS MADE IN JAPAN

## SPECIFICATIONS

**Application:** For 2/3" low light level CCTV camera

**Type:** Motorized EE zoom lens with a built-in attenuator for controlling a wide range of illumination change

**Range of Focal Length:** 12.5 – 75mm

**Maximum Relative Aperture:** 1 : 1.8

**Zoom Ratio:** 6×

**EE Mechanism:** It amplifies the difference between the video signals from the camera and the presetting standard level so that it puts the iris into motion. The EE Amplifier is built in Control Box CC-7T.

**EE Working Range:** F1.8 ~ approx. F360 (1:1/4.00 × $10^4$) Adjusted by the combined operation of the built-in attenuator and the iris.

**EE Accuracy:** With input video signal 0.3V Within ±15% of mean value

**Angular Fields of View:** 37.9° × 29° at 12.5mm
6.9° × 5.1° at 75mm

**Image Format Covered:** 8.8 × 6.6mm (11mmφ)

**Number of Lens Elements:** 14 elements in 11 components

**Clear Aperture of Front Glass:** 43.5mmφ

**Clear Aperture of Rear Glass:** 14mmφ

**Minimum Object Distance:** 1.0m (from focal plane)

**Object Dimensions at Minimum Object Distance:**
55.5 × 41.6cm at 12.5mm 9.7 × 7.3cm at 75mm M58

**Optical Back Focal Distance:** 16.72mm

**Mechanical Back Focal Distance:** 17.526mm

**Operation System:** Zoom and focus by [illegible] levers of Control Box CC-7T. Iris by EE Amplifier

**Operation Speed:**
Zoom approx. 3.5 sec
Focus approx. 5 sec
Iris approx. 4 sec. (2 sec. at 4 EV)

**Mount:** C-Mount Orientation of the lens is adjustable.

**Front Thread:** 72mm P0.75

**Distance from Front Vertex to Focal Plane:** [illegible]mm

**Size:** 100φ × 131.5mm

**Weight:** approx. 1.2kg (2 lbs. 10 ozs.)

**[Control Box CC-7T]**

**Input Voltage:** AC 100, 115, 220, 240V

**Input Signal:** Synchro Signal 0–0.5V Video Signal 0.3–1.5V

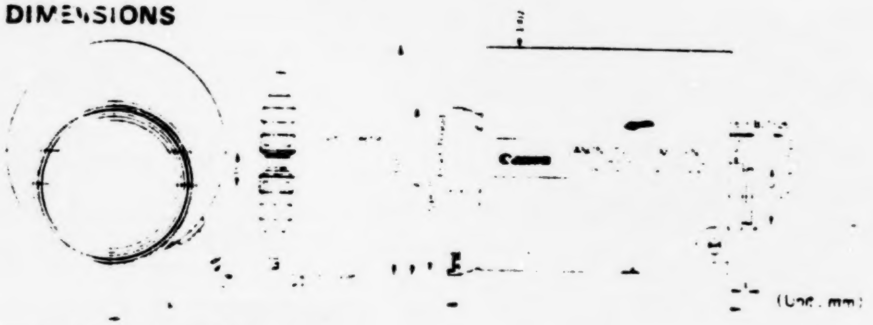
**Input Impedance:** more than 47 KΩ

**Operational Temperatures:** −10°C ~ 50°C (14°F ~ 122°F)

## COMPOSITION

| | |
|---|---|
| **J6 × 12 REA (DC) Lens** | 1 |
| **[illegible] Cap** | 1 |
| **[illegible] Cap** | 1 |

## DIMENSIONS



## CIRCUIT DIAGRAM

## CIRCUIT DIAGRAM COMPONENTS

| Diagram No | Item | Rating |
|---|---|---|
| M1 ~ M3 | Micromotor | DC 7V |
| MS | Micro Switch | |
| D | Ge Diode | 120mA |
| NF [illegible] | Noise Filter Unit | |
| CN | Connector | Hirshmann Mas 410C |
| CN2 | | Hirshmann Mas 410C |

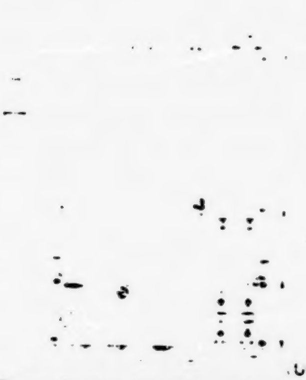
---

OPTIONS

1. Control Box CC-7T (AC 100, 115, 220, 240V)
2. Connecting Cable (4-conductor 10m without connectors
3. Extender 2 x A2
4. 72mm Close-up Lens 1100-2, 2100-2
5. 72mm Filter ND4, ND8

[CONTROL BOX CC-7T]

### DIMENSIONS



### CIRCUIT DIAGRAM

### CIRCUIT DIAGRAM COMPONENTS

| [illegible] | [illegible] | [illegible] |
|---|---|---|
| [illegible] | [illegible] | [illegible] |
| [illegible] | NPN Transistor | 2SC1061 |
| [illegible] | PNP Transistor | 2SA671 |
| [illegible] | [illegible] | |
| LED | Light Emitting Diode | TLH 104 |
| F | Fuse | 0.5A |
| PCB-1 | Printed Circuit Board | |
| PCB-2 | Printed Circuit Board | CCTV Lens Control Unit v.5.2 |
| ZD1, 2 | Zener Diode | RD7AL |

**For extending the distance between the lens and the control box, extra connecting cable is available up to about 300m (984ft.)**

Specifications, composition and dimensions are subject to alterations.

**Canon**

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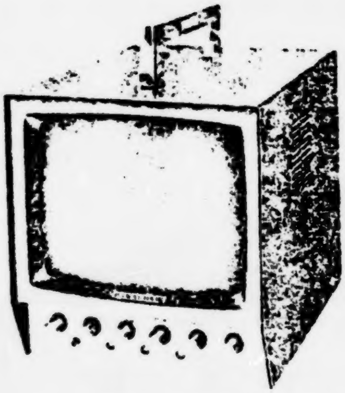
**PANASONIC**

# "TYPE 9" HIGH-RESOLUTION MONITOR TV
## MODELS TN-95, TN-952
## TN-93, TN-932



**MODEL TN-95**

**MODEL TN-952**

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## SPECIFICATIONS TN-95, TN-952

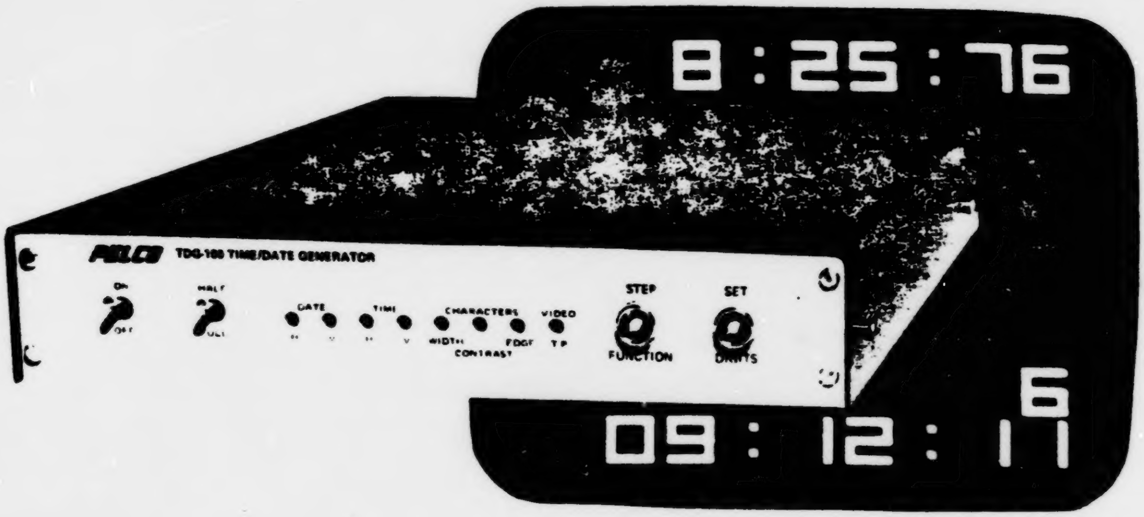
| | |
|---|---|
| Power Voltage: | AC 117 V |
| Power Frequency: | 60 Hz |
| Power Consumption: | 40 W (TN-95) 80 W (TN-952) |
| Audio Output: | 400 mW (8Ω) |
| Audio Frequency Response: | 500 Hz ~ 5 kHz (−3 dB point) where.<br>1 kHz = 0 dB |
| Audio Input: | 30 mVRMS (High impedance)<br>unbalanced. |
| Audio Input Impedance: | High impedance (3 kΩ or higher)<br>Bridge is practicable |
| Video Input Impedance: | 75Ω High impedance (10 kΩ or higher)<br>Switching Bridge is practicable. |
| Video Input: | V.S. 1 Vp-p or V. 0.7 Vp-p<br>Positive Polarity Unbalanced |
| Resolution: | Horizontal Center 700 lines<br>Horizontal Surrounding 550 lines<br>Vertical 350 lines |
| Video Frequency Response: | With Max. Resolution: 10 MHz or more (−3 dB. 100 kHz = 0 dB)<br>With Med. Resolution: 8 MHz or more (−3 dB. 100 kHz = 0 dB)<br>With Min. Resolution: 3 MHz or more (−3 dB. 100 kHz = 0 dB) |
| Sync Input Impedance: | High Impedance (15 kΩ or more)<br>Bridge is practicable |
| Sync Input: | 4 Vp-p Negative Polarity<br>(Compound Sync Signal) Unbalanced. |
| V. Sync Input: | 10 Vp-p Negative Polarity<br>(From a large VTR) Bridge is practicable. |
| Dimensions: | 10-1/8"(H) × 9"(W) × 11-7/16"(D) (TN-95)<br>9-33/64"(H) × 8-31/32"(W) × 11-29/64" (TN-952) |
| Weight: | 18.74 lbs. (TN-95) 37.48 lbs (TN-952) |

**PELCO**

## MODEL TDG-100
## TIME/DATE GENERATOR

- TIME & DATE SETS LIKE ELECTRONIC DIGITAL WATCH
- HORIZONTAL AND VERTICAL POSITIONING-ANYWHERE
- CHARACTERS ADJUSTABLE TO 7, 14, OR 28 VIDEO LINES
- FRONT CONTROLS AND VIDEO TEST POINTS
- POSITIVE CONTRAST EDGED CHARACTERS
- WHITE ON BLACK, OR BLACK ON WHITE
- 399 YEAR AUTOMATIC CALENDAR
- OPTIONAL INTERNAL BATTERY
- TENTH OF A SECOND DISPLAY
- COMPUTER COMPATIBLE FOR DATA DISPLAY
- OPTIONAL CAMERA TALLY

**'ALL NEW'**



The Pelco **TDG-100** is an all "Digital" Time/Date Generator, which superimposes time and date characters on any video monitor or television screen. Ultra modern in electronic design, the operation of the **TDG-100** is unique to the video industry and a first in the marketplace.

The **TDG-100** includes many features not found on higher priced units. All functions set like an "electronic digital watch", with time and date characters able to be positioned anywhere on the active picture area. Easy to read, positive contrast edged characters, adjustable to 7, 14, or 28 video lines accomodate those applications requiring small, medium or large numerals. The 399 year calendar "automatically" adjusts for correct numbers of days in a month or leap year.

The optional internal battery guarantees continuous operation during intermittent power or extended remote use. All controls are easily accessible on the front panel, including video test points.

PELCO SALES, INC. / THE LEADER IN ACCESSORIES FOR THE TELEVISION INDUSTRY

# SPECIFICATIONS

| RACK MOUNT | DESK TOP |
|---|---|
| **MODEL** | **MODEL** |
| TDG-100-R | TDG-100-DT |
| TDG-100-RB W/Battery | TDG-100-DTB W/Battery |

## OPERATION

**STEP-N-SET :** Step Button advances through 8 positions
Position 1 – Seconds; 2 – Minutes; 3 – Hours; 4 – Days;
5 – Month; 6 – Year; 7 – Run/Normal; 8 – 1/10 Second Off
Set Button allows for automatic incrementing of unblanked position.

## CONTROLS

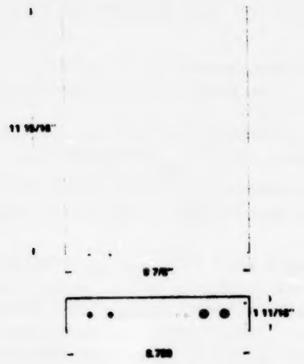
**RECESSED SCREWDRIVER**
**ADJUSTMENTS :** Time & date horizontal & vertical positioning, character width, contrast, video test point
**POWER SWITCH :** On/Off (Off position permits video to loop thru)
**SIZE CONTROL :** 7 and 14 video lines high, 28 line adjustment via horizontal control
**AUTOMATIC :** 399 Year Calendar adjusts for correct day and leap year.
(Below normal battery condition is noted by flashing digit.)

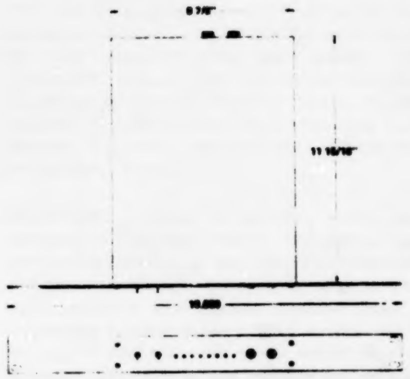
## ELECTRICAL

**INPUT :** 1 to 1.4VP-P Composite Video, SYNC negative accepts monochrome, NTSC, PAL M, SECAM or CCIR, Random or Configured Interlace 50/60 HZ, 401 to 1029 line rate.
**OUTPUT :** Unity Gain Composite Video Signal with characters superimposed.
**INPUT POWER :** UL Approved AC Adapter/Charger provides 12V pulsed DC, 300 MA, 50/60 HZ
**CONNECTORS :** UHF SO-239, Miniature Phone Jack for 12VDC input
**TEMPERATURE :** 32 F. to 115 F. (0° C to 45° C)
**WEIGHT :** 2.4 lbs. net, 3.4 gross (1.09 Kg)

## OPTIONS

**INTERNAL BATTERY :** Rechargeable, Solid GE 12VDC, 1AH. Enables TDG-100 to automatically switch to crystal operation during intermittant power or extended remote use.





Specifications subject to change without notice

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VICON® INDUSTRIES INC. 125 E. BETHPAGE RD., PLAINVIEW, N.Y. 11803 TEL. 516 293 2200

# VICON V106AC-000-01 AND V107AC-000-01 AUTO IRIS CONTROLS

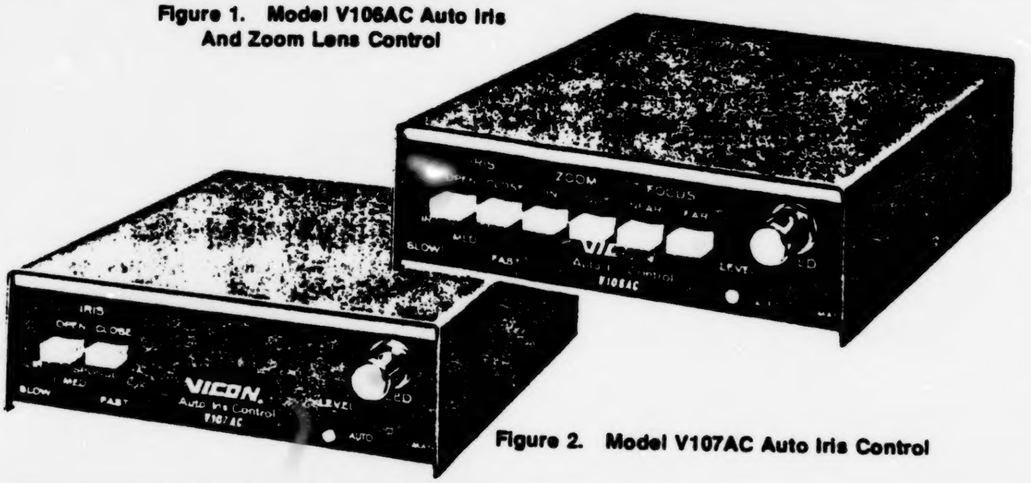


**Figure 1. Model V106AC Auto Iris And Zoom Lens Control**

**Figure 2. Model V107AC Auto Iris Control**

## INTRODUCTION

Vicon's V106AC or V107AC Auto Iris Control units figures 1 and 2 can be used to automatically or manually drive the iris servo of a TV camera lens. Each unit features a completely solid-state iris drive circuit that can automatically maintain constant video throughout the iris range. Average video amplitude can be adjusted by the operator as it appears on a TV monitor. Manual or automatic iris drive, auto iris response speed, and manual iris adjustment speed are provided by both units. When used with a sensitive camera and a proper lens, either unit will enable operation under lighting conditions from very bright sunlight to partial darkness.

The V106AC, in addition to iris control, enables pushbutton control of zoom and focus of the TV camera lens.

The V106AC operates with Vicon INTRASPOT$_{TM}$ Zoom lenses; V107AC with Vicon INTRASPOT$_{TM}$ fixed focal length lenses.

These controls will also operate Vicon standard zoom lenses or fixed focal length lenses equipped with iris limit switches (VSW option).

For Vicon INTRASPOT$_{TM}$ Motorized Zoom lenses or standard Motorized Zoom Lenses, a four-conductor, shielded cable is required. For INTRASPOT$_{TM}$ or standard Motorized fixed focal length lenses, a two-conductor shielded cable is required. Models V106AC and V107AC will operate a lens up to the following distances (with iris response set to MED or FAST):

| Wire Size, AWG | Distance, Ft. |
|---|---|
| 22 | 1000 |
| 20 | 1600 |
| 18 | 2300 |

INTRASPOT$_{TM}$ lenses incorporate a special graduated filter spot in the lens itself. As the iris closes, filter attenuation increases, thus allowing a camera to operate over an extremely wide light gradient, depending upon lens. There is no point at which a filter is rotated in or out of the optical path.

VSW option is specified when it is desired to use a standard Vicon motorized lens with Auto-Iris Control. This option is necessary with auto-iris operation in order to switch off the iris drive when lighting conditions are such that the iris is servo-driven to either the fully closed or fully open position. The VSW option incorporates internal limit switches to interrupt current flow to the iris motor when iris limits are reached. Switches are rated at 5 amperes, 10 million cycles. When ordering a Vicon motorized iris lens with this option add the suffix (–SW) to lens model number for example, V16-160M-SW.

DAYONITE$_{TM}$ option is specified when extension of night operation is especially desired. This option must be used with Vicon's DAYONITE$_{TM}$ lens. The Vicon DAYONITE$_{TM}$ motorized lens extends light transmission range to allow both day and night operation with modern sensitive video systems. A light attenuating (neutral density) filter is automatically inserted into the optical path when the motor driven iris closes to its highest f-number. The filter is then removed automatically when the iris reaches wide open position. This provides two ranges of f-stops. With the filter in place, only a small percentage of light is transmitted, allowing full daylight operation of the same camera that operates at full sensitivity under conditions of partial darkness.

# MODELS V106AC AND V107AC SPECIFICATIONS

## OPERATIONAL

**Zoom:** In-Out Pushbuttons (V106AC only)

**Focus:** Near-Far Pushbuttons (V106AC only)

**Manual Iris:** Open-Close Pushbuttons

**Auto Iris:** Manual-Auto Slide Switch

**On-Off and Speed:** Knob Control

**Iris Response:** 3 position switch (Slow, Medium, Fast)

**Video Level:** Panel knob adjust

**Termination:** 75 ohm In-Out switch at rear

**Pilot Light:** Long Life LED indicator

## MECHANICAL

**Size (Desk Top):**
- **Height:** 2.06 inches
- **Width:** 5.87 inches
- **Depth:** 6.13 inches (Not including connector or front panel controls)

**Size (Racked):**
- ***Height:** 1.75 inches
- **Width:** 19.00 inches
- **Depth:** 5.75 inches (Behind panel, excluding connectors)

**Weight:** 4 pounds

**Construction:** Steel chassis and cover.

**Finish:** Black baked enamel chassis. Grey vinyl textured cover.

## ELECTRICAL

**Input Voltage:** 115 VAC 50/60 Hz (220 VAC Operation by rewiring power transformer)

**Power Consumption:** 3.6 Watts

**Output Voltage:** 2 to 8 volts DC

**Iris Control:** Direct coupled solid state

**Filter Drive optional (for Dayonite lenses only):** 5 volts DC

**Termination:** 75 ohms (optional with switch)

**Circuit Design:** Solid state throughout

**Line Cord:** Standard 3 conductor SV #18 AWG cable with grounded plug.

**Video Level:** 0.6-1.5 vp-p

**Output Connector:** Switchcraft 61HA5F (Mating connector Switchcraft 12CL5M supplied)

**Video Input Connector:** SO-239

**Video Output Connector:** SO-239

**Fuse:** 3AG ½ Ampere

**Lens Cable Requirements:** V106AC DAYONITE$_{TM}$ Lenses. 5 conductor shielded. (Optional)
INTRASPOT or Vicon standard motorized lenses: 4 conductor shielded.
V107AC 2 conductor shielded. 3 conductor shielded. Optional for DAYONITE$_{TM}$

**Video Cable:** Standard UHF

The unit operates up to the following distances from the lens:

| Wire Size (AWG) | Distance, Feet |
|---|---|
| 22 | 1000 |
| 20 | 1600 |
| 18 | 2300 |

---

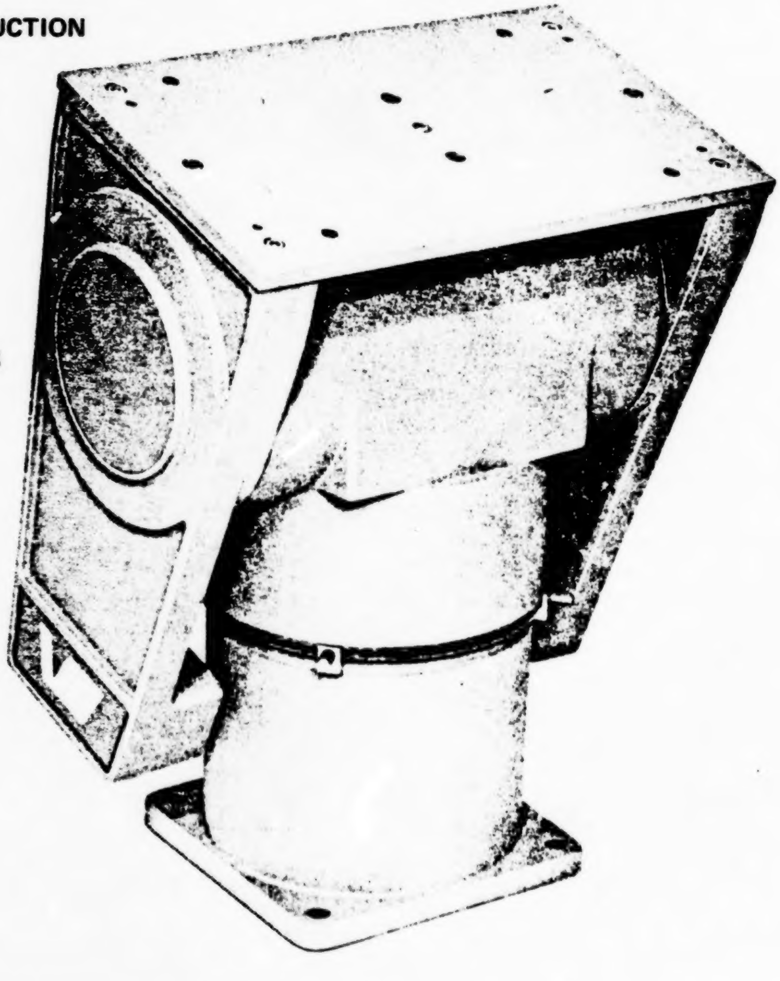
*Units may be racked in single, double or triple versions.

**VICON INDUSTRIES INC.**

# MODELS V300PT AND V300-115PT PAN AND TILT DRIVES

PAT *

- **RUGGED, HEAVY-DUTY CONSTRUCTION**
- **HARDENED STEEL GEAR TRAIN**
- **LOW VOLTAGE AC OPERATION (V300PT MODEL)**
- **LOW CURRENT AC OPERATION (V300-115PT MODEL)**
- **COUNTERBALANCED DESIGN**
- **HEAVY-DUTY ROLLER BEARINGS**
- **INDOOR-OUTDOOR RATED**
- **LIFETIME LUBRICATION**



The design of Models V300PT and V300-115PT has been proven through years of service. Unique counterbalancing springs and weights maintain an even load over the entire tilt range to counteract the effects of off-center loading. The heart of these Pan and Tilt Drives is their rugged AC motor and gear train with hardened steel gears designed for smooth operation and minimum wear. These units are made of cast aluminum and plate construction, sealed to withstand adverse conditions, and are finished in an attractive grey vinyl-textured enamel.

*PAT NO D 226 135

**VICON INDUSTRIES INC. 130 CENTRAL AVENUE FARMINGDALE NEW YORK 11735 TELEPHONE 516 293 2200**

# SPECIFICATIONS

## OPERATIONAL

| | |
|---|---|
| **Angular Travel:** | Pan; 350° max.<br>Tilt; ±90° max. |
| **Stops:** | Externally adjustable. |
| **Speed:** | Pan; 6°/second.<br>Tilt: 4°/second. |
| **Load Rating (Based on C.G. to center of tilt rotation distance of 10 inches):** | **Vertical**; 35 lbs.<br>**Inverted**; 30 lbs. |
| **Braking:** | Automatically engaging spring brake on pan and tilt. |
| **Ambient Temperature Range:** | -65°F to +165°F. |
| **Overload Protection:** | Motor thermal overload on pan and tilt. |
| **Duty Cycle:** | Pan; Intermittent.<br>Tilt; Intermittent. |

## MECHANICAL

| | |
|---|---|
| **Size:** | **Height**; 13.87"<br>**Width**; 10.75"<br>**Depth**; 6.50" |
| **Weight:** | 38 lbs. |
| **Construction:** | Cast aluminum housing. All parts corrosion-protected steel or aluminum. |
| **Finish:** | Baked grey-vinyl textured enamel. |
| **Bearings:** | Heavy-duty roller bearings. |
| **Gears:** | Hardened steel. |
| **Seals:** | Quad ring and gasket seals for all-weather environmental protection. |

## ELECTRICAL

| | |
|---|---|
| **Input Voltage:** | 24V 50/60 Hz (V300PT);<br>115V 50/60 Hz (V300-115PT). |
| **Input Power:** | **Pan**; 45 VA at 24V; 35 VA at 115V<br>**Tilt**; 45 VA at 24V; 35 VA at 115V |
| **Normal Operating Current:** | **Pan**; 1.8 amp at 24V; 0.3 amp at 115V.<br>**Tilt**; 1.8 amp at 24V; 0.3 amp at 115V. |
| **Limit Switches:** | 5 amp., 10-million cycle rating. |
| **Connectors:** | MS3102E16S-1P. (Mating connector MS3106E16S-1S supplied for 24V version.)<br>MS3102E16S-1PW. (Mating connector MS3106E16S-1SW supplied for 115V version.) |
| **Cable Requirements:** | 7 conductor, unshielded. |

## ELECTRICAL (cont'd)

The V300PT or V300-115PT will operate at full rating up to the distances shown on the following chart using annealed copper wire:

| | Max. Distance (Ft) | |
|---|---|---|
| Wire Size (AWG) | V300PT (24V) | V300-115PT (115V) |
| 20 | 250 | 1,600 |
| 18 | 400 | 2,500 |
| 16 | 650 | 4,000 |
| 14 | 1,000 | 6,400 |

# ACCESSORIES

## CONTROLS

| | |
|---|---|
| **Model V110PT:** | Pushbutton operation (ComPacLine$_{TM}$) 24V output for use with V300PT. Will also operate with V180R Relay Box. The V300-115PT may be used with this control if the V183R Relay Box is used. |
| **Model V111PT:** | Same as V110PT, but has joystick for pan and tilt control. |
| **Model V119PT:** | Pushbutton operation (ComPacLine) 115V output for use with V300-115PT without relay box. |
| **Model V120PT:** | Same as V119PT, but has joystick for pan and tilt control. |

Control units provide control of pan, tilt and power on-off. Rack mounting available.

## RELAY BOX

When greater-than-normal cable lengths are necessary, use a relay box as follows.

For V300PT (24V) use V180R.

For V300-115PT (115V) employing 24V control voltages use the V183R. (V110PT or V111PT control must be used with relay box.)

The relay boxes will operate up to 15,000 ft. with AWG #18 annealed copper wire. (See catalog sheet no. 133 for data on V180R and V183R Relay Boxes.)

## MOUNTS

For wall mounting use V24WM (see catalog sheet no. 132).

For ceiling mounting use V10CM, V20CM, V36CM (see catalog sheet no. 139).

For pedestal mounting use V10PM, V20PM, V36CM (see catalog sheet no. 139).

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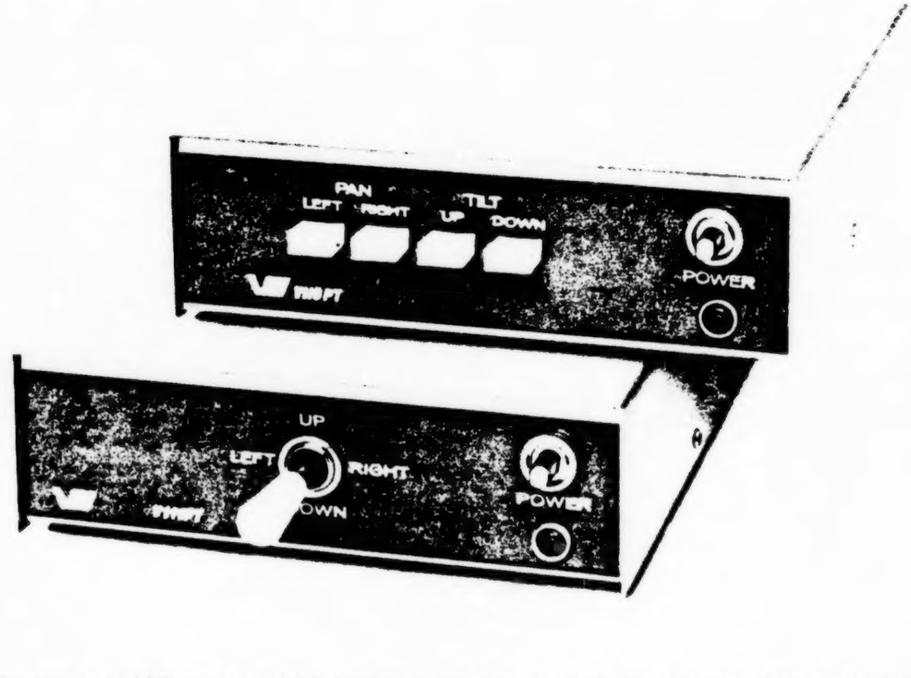
·COM PAC LINE·™

**VICON INDUSTRIES INC.**

# MODEL V110PT AND V111PT PAN AND TILT CONTROLS

- UNIQUE, RELIABLE MOTOR CONTROL
- EASILY OPERATED
- SMOOTH PAN AND TILT MOTION



The Models V110PT and V111PT Controls are for use with the Vicon Models V300PT and V340PT Pan and Tilt Drives. These compact units will also provide 24-volt control voltage for driving the Vicon Models V380PT, V380PTX or V300-115PT Pan and Tilt units at long distances when used with the V183R Relay Box.

Designed to be compatible with Vicon ComPacLine modules, either unit can be furnished in rack or desk-top versions.

**VICON INDUSTRIES INC. 125 EAST BETHPAGE RD. PLAINVIEW NEW YORK 11803 TEL. 516 293 2200 TELEX 144581**

# SPECIFICATIONS

## OPERATIONAL

### CONTROLS

**Model V110PT:** Pan; Pushbutton left-right.
Tilt; Pushbutton up-down.
**Model V111PT:** Pan and Tilt; Single joystick control.
**Main Power:** Pushbutton on-off.
**Pilot Light:** Long-life neon.

## MECHANICAL

**Size (Desk Top):** Height; 2.06"
Width; 5.87"
Depth; 7.22"*
**(Racked):** Height; 1.75"
Width; 19.00"
Depth; 6.44"**

*On the V111PT, joystick extends an additional 2.15".

**On the V111PT, joystick extends an additional 1.47".

Units may be racked in single, double or triple versions.

**Weight:** 4 lbs.
**Construction:** Black, baked-enamel steel chassis. Gray vinyl-textured steel cover.

## ELECTRICAL

**Input Voltage:** 115V 50/60Hz. (230VAC operation may be specified.)
**Maximum Power Consumption:** 48W.
**Output Voltage:** 24V 50/60Hz.
**Line Cord:** Standard 3 conductor SV #18 AWG cable and grounded plug.
**Fuse:** 3AG - 2 ampere.
**Output Connector:** Cinch S-310-AB. Mating connector P-310-CCT supplied.

The V110PT and V111PT will control Models V300PT and V340PT Pan and Tilt units at full rated load up to the following distances:

| WIRE SIZE (AWG) | MAX. DISTANCE (FT.) |
|---|---|
| 20 | 250 |
| 18 | 400 |
| 16 | 650 |
| 14 | 1,000 |

# ACCESSORIES

## RELAY BOXES

### Model V180R

When greater-than-normal cable lengths are required (up to 15,000 ft. with AWG #18 wire) the Model V180R Relay Box is required.

### Model V183R

For use when the V380PT, V380PTX or V300-115PT Pan and Tilt units are used either for low-voltage (24VAC) wiring or when distances up to 15,000 ft. are required. See catalog sheet no. 133.

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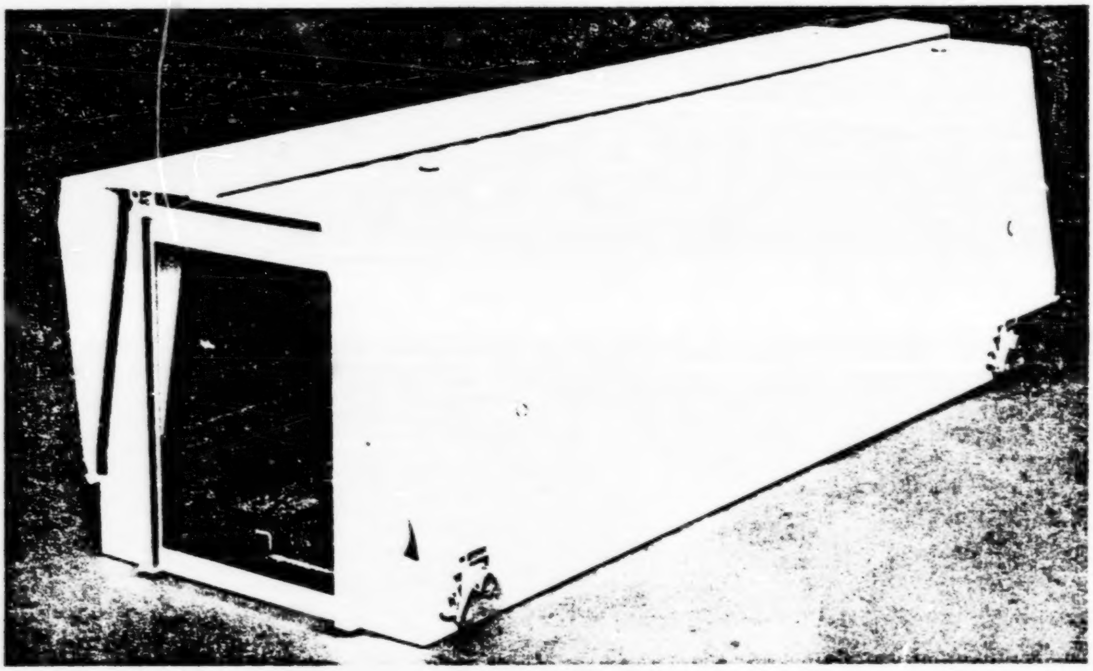
**VICON INDUSTRIES INC.** VII®

# MODEL V800H ENVIRONMENTAL ENCLOSURE

- WEATHERPROOF
- EXCLUSIVE DUAL-ACTING HINGED COVER
- ANTIFOG AIR CIRCULATION
- CONVECTIVE SELF-CIRCULATING AIRFLOW
- RADIANT HEAT-REFLECTIVE FINISH
- LIGHTWEIGHT, BUT STURDY



The Vicon Model V800H Enclosure is constructed of durable aluminum and finished with a weatherproof heat-reflecting paint. The unique hinged cover permits access from either side, or the cover can be completely removed. This feature permits adjustment to the camera in locations where the cover cannot be placed aside or where exposure of the camera is undesirable as would be the case in inclement weather.

A rear air-inlet port has been provided to permit a convective flow of air from rear to front, thus drawing heat away from the camera and circulating it past both sides of the window in order to prevent fogging.

A heater with thermostat control and a filtered-air, positive-pressure blower system are available. The blower outlet port has been designed to create a washing airflow across the front surface of the window.

## SPECIFICATIONS

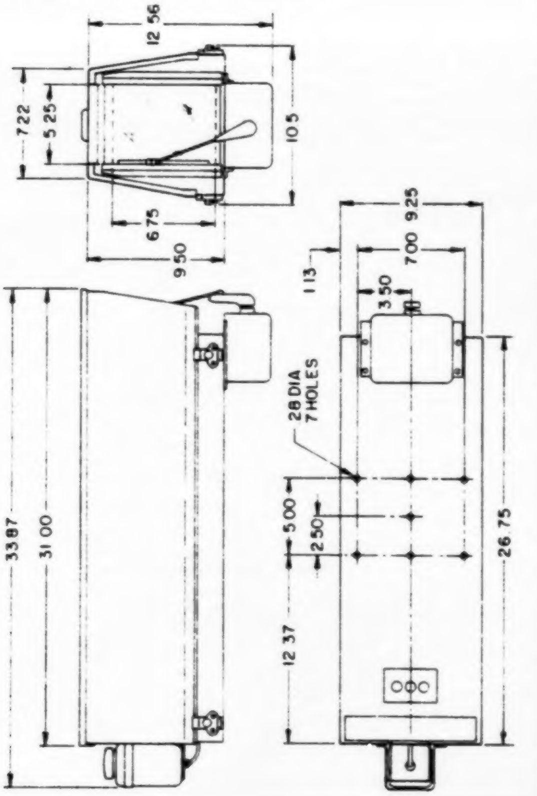
### MECHANICAL

| | | |
|---|---|---|
| **Size (external):** | Height; | 9.5" |
| | Width; | 10.5" |
| | Length: | 31.0" |
| **Size (internal):** | Height; | 8.00" |
| | Width; | Top – 7.00"<br>Bottom – 8.50" |
| | Length; | 25.00" (without blower).<br>23.50" (with blower). |
| **Weight:** | | 12.5 lbs. |

## ACCESSORIES

**Model V800H-H Heater**
Blanket-type heater set operates at 115V 50/60Hz. Provides 225 watts of heating power with preset thermostat for closure at temperatures below 35°F. Maintains internal temperature at 35°F with external temperatures down to -10°F.

**Model V800H-I Insulation**
Efficient polyurethane insulation helps to maintain internal temperature within operating limits of both hot and cold environments. When used with Model V800H-H Heater, maintains internal temperature above 35°F with outside temperature down to -30°F. Also effective in conjunction with sunshield for protection from rays of the sun. Reduces internal height by 1/2" and width by 1".



## ACCESSORIES (Con't.)

**Model V800H-LT Extreme Low-Temperature Package**
Consists of blanket-type heater set mounted on special isolated radiator panels. Prevents excessive radiation of heat to the outside. Includes insulation. Maintains internal temperature above 35°F with outside temperature down to -80°F.

**Model V800H-B Blower**
Completely internal positive-pressure, silent fan provides 115 CFM of airflow through a bottom intake and filter. Furnished with preset thermostat for closure at 90°F 115V 50/60Hz.

**Model V800H-S Sunshield**
Lightweight, white vinyl-textured finish sunshield protects enclosure from direct solar heat. Shields permit airflow over housing exterior without interfering with cover operation.

**Model V800H-W Window Wiper**
High torque, long-life wiper-motor/wiper-arm combination. Designed to stop out of viewing area and wipe full window surface. Operates at 115V 50/60Hz. Consumes 27 watts.

**Model V800H-WW Window Wiper and Washer**
Internally mounted high-pressure pump assembly with long-life check valve. Refillable, unbreakable washer-supply bottle holds enough solution for 70 washes. Operates at 115V 50/60Hz.

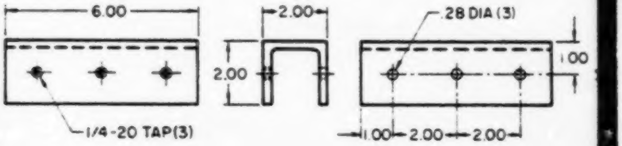
**Model V800H-T Tamperproof Locks**
Keyed locks for each hinged side of housing cover. Two keys supplied.

**Model V800H-TM Top Mounting Bracket**
Used for suspending housings from overhead mounting. Fastens to top cover of housing.

**Model V190C Housing Control**
Controls functions of camera and enclosure power, wiper, washer, blower and heater. Available in either desk-top or rack models. Operates at 115V 50/60Hz.

**Model V192C Housing Control**
Same as Model V190C except provides low-voltage operation of housing. Use in conjunction with Model V185R Relay Box.

**Model V11CA Camera Support**
Used for mounting of cameras having low optical centerline.



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# INSTRUCTIONS
# FOR OPERATION
# AND INSTALLATION

## *V300PT SERIES PAN AND TILT DRIVES*
## *(24 VAC and 115 VAC Versions)*

M71

VICON INDUSTRIES INC. 125 EAST BETHPAGE RD. PLAINVIEW NEW YORK 11803 TELEPHONE 516 293 2200 TELEX 144581

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# SCOPE

The information in this Instruction Sheet is intended to cover the operation, installation, and maintenance of the following model pan and tilt drives:

V300PT-000-00
V300PT-010-00
V300PT-020-00
V300PT-001-00
V300-115PT-000-00
V300-115PT-020-00

In this Instruction Sheet, the term V300PT is used to refer to all models of this series unless specifically stated otherwise.

The following model control units and relay boxes used in conjunction with V300PT Series units are also covered in this Instruction Sheet:

| Controls | Relay Boxes |
|---|---|
| V110PT-000-00 | V180R-000-00 |
| V111PT-000-00 | V183R-000-00 |
| V119PT-000-00 | |
| V120PT-000-00 | |

VICON INDUSTRIES INC. 125 EAST BETHPAGE RD. PLAINVIEW NEW YORK 11803 TEL. 516 293 2200

# INSTRUCTIONS FOR OPERATION AND INSTALLATION

## *V300PT SERIES PAN AND TILT DRIVES (24 VAC and 115 VAC Versions)*

## INTRODUCTION

The V300PT is a medium-duty Pan and Tilt Drive employing a counterbalance system. The unit is designed for loads up to 35 pounds, or 30 pounds when mounted in the inverted position. Drive motors are constructed with factory-lubricated, hardened-steel gear trains that will not require field lubrication. Quad ring seals with teflon wear surfaces provide protection in severe environments. Operational stability with minimum coast is provided by self-energizing brakes integral with the drive motors.

A choice of two input voltages is available in this series. Model V300PT is energized with 24 VAC and Model V300-115PT is energized with 115 VAC. The low-voltage model can be used in cases where less stringent wiring requirements are desired. Several controls are available for use with this series. The V300PT may be energized through a control unit or a combination of a control unit and a relay box.

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# SPECIFICATIONS

## OPERATIONAL

**Angular Travel:** Pan; 350° max.
Tilt; ±90° max.

**Stops:** Externally adjustable.

**Speed:** Pan; 6°/second.
Tilt: 4°/second.

**Load Rating:** Vertical, 35 lbs.
Inverted, 30 lbs.
(Based on C.G. to center of tilt rotation distance of 10 inches.)

**Braking:** Automatically engaging spring brake on pan and tilt.

**Ambient Temperature Range:** -65°F to +165°.

**Overload Protection:** Motor thermal overload on pan and tilt.

**Duty Cycle:** Intermittent.

## MECHANICAL

**Size:** **Height;** 13.87"
**Width;** 10.75"
**Depth;** 6.50"

**Weight:** 38 lbs.

**Construction:** Cast aluminum housing. All parts corrosion-protected steel or aluminum.

**Finish:** Baked gray vinyl-textured enamel.

**Bearings:** Heavy-duty roller bearings.

**Gears:** Hardened steel.

**Seals:** Quad ring and gasket seals for all-weather environmental protection.

## ELECTRICAL

**Input Voltage and Power:** **Model V300PT;** 24VAC 50/60Hz.
Pan or Tilt Power; 45VA (each).
**Model V300-115PT;** 115VAC 50/60Hz.
Pan and Tilt Power; 35VA (each).

**Normal Operating Current:** Pan; 1.8 amp at 24V; 0.3 amp at 115V.
Tilt; 1.7 amp at 24V; 0.3 amp at 115V.

**Limit Switches:** 5 ampere, 10 million cycle rating.

**Cable Requirements:** 7 conductor, unshielded.

**Connectors:** **Model V300PT;** MS3102E16S-1P. (Mating connector MS3106E16S-1S supplied.)
**Model V300-115PT;** MS3102E16S-1PW. (Mating connector MS3106E16S-1SW supplied.)

**The V300PT or V300-115PT will operate at full rating up to the following distances using annealed copper wire:**

| | Max. Distance (Ft.) | |
|---|---|---|
| **Wire Size (AWG)** | **V300PT (24V)** | **V300-115PT (115V)** |
| 20 | 250 | 1,600 |
| 18 | 400 | 2,500 |
| 16 | 650 | 4,000 |
| 14 | 1,000 | 6,400 |

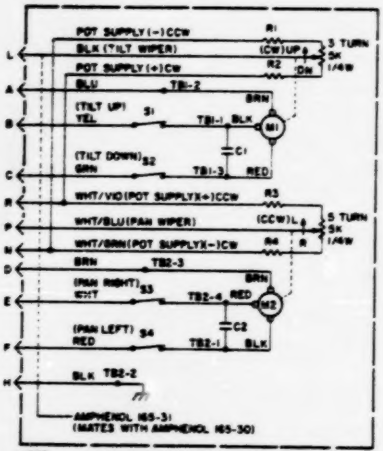
---

# OPTIONS

**LIMIT STOP: When necessary to prevent the camera from tilting above horizon level, the V502ST or V502STL (for inverted mounting) Limit Stop Assemblies should be ordered. The limit stop is simply installed by removing the existing stop and replacing it with the V520ST or V502STL.**

**VPR AND VPP OPTIONS: Certain CCTV applications require that the position of the camera in pan and tilt must be accurately known or predetermined. This requires that the unit be equipped to send an analog signal back to the control unit. Vicon pan and tilt drives with this feature are ordered with the VPR or VPP option.**

**The VPR option permits the V300PT to be used with the V124PR Remote Position Readout unit, while the VPP option permits the V300PT to be used with the V129-8PP Preset Position Control. When this option is specified, the V300PT Pan and Tilt Drive is furnished with potentiometers driven by the pan and tilt mechanism, respectively. The potentiometers furnish a resistance which is analogous to the pan and tilt position. See Figure 1 for a schematic of the V300PT unit showing the electrical connection of the potentiometers.**


POT SUPPLY (-) CCW
BLK (TILT WIPER)
POT SUPPLY (+) CW
R1
R2
(CW) UP
DN
3 TURN
5K
1/4W
L
A
B
C
R
P
N
D
E
F
H
BLU
TB1-2
BRN
(TILT UP)
YEL
S1
TB1-1
BLK
M1
C1
(TILT DOWN)
S2
GRN
TB1-3
RED
WHT/VIO (POT SUPPLY) (+) CCW
R3
WHT/BLU (PAN WIPER)
(CCW) L
R
5 TURN
5K
1/4W
WHT/BRN (POT SUPPLY) (-) CW
R4
BRN
TB2-3
BRN
(PAN RIGHT)
S3
WHT
TB2-4
RED
M2
C2
(PAN LEFT)
S4
RED
TB2-1
BLK
BLK
TB2-2
AMPHENOL 165-31
(MATES WITH AMPHENOL 165-30)

NOTE
1. RESISTORS R1, R2, R3, AND R4 ARE 1KΩ, 1/8W
2. ON MODEL V300PT CAPACITORS C1 AND C2 ARE 88-108mfd, 125WV
3. ON MODEL V300-115PT CAPACITORS C1 AND C2 ARE 4mfd, 236-330WV

**Figure 1 Schematic Diagram of VPR and VPP Options**

# ASSOCIATED EQUIPMENT AND ACCESSORIES

Several combinations of V300PT models and control voltages are available. The choice will depend upon installation criteria for individual cases. (See Vicon Technote No. 274 for a complete discussion of pan and tilt installation criteria.) Table I shows combinations of control and pan and tilt models that may be used and maximum distances possible between control and unit. The term *control voltage* refers to the voltage carried by the connecting cable between the control and the camera station at which the pan and tilt drive is located. The following discussion describes each control:

**MODEL V110PT PAN AND TILT CONTROL:** This model uses pushbutton control for pan left-right and tilt up-down. A 24-volt transformer is incorporated in the control to energize the V300PT directly from the control, or through the use of a relay box.

**MODEL V111PT PAN AND TILT CONTROL:** This control uses a specially designed joystick switch for up-down and right-left control, allowing the operator to maneuver the camera without looking away from the monitor. A 24-volt transformer is incorporated to control the Model V300PT directly or by means of a relay box.

**MODEL V119PT PAN AND TILT CONTROL:** This model uses pushbutton controls and is identical to the V110PT except that a transformer is not used. This unit is designed to energize Model V300-115PT directly.

**MODEL V120PT PAN AND TILT CONTROL:** This model is the same as the V119PT except that the joystick switch is incorporated for pan and tilt operation.

**MODEL V180R RELAY BOX:** This accessory is used with the Model V300PT (24V version only). See Table I. Relays are housed in a modified NEMA 12 weatherproof enclosure measuring 4-1/4" high, 6-1/2" wide and 6-1/4" deep. A 24V stepdown transformer within the relay box energizes the pan and tilt drive through the relays.

**MODEL V183R RELAY BOX:** This model is identical to the Model V180R but does not have the 24V stepdown transformer. It is used with Model V300-115PT only. See Table I.

NOTE: Model V110PT or V111PT Pan and Tilt Controls must be used when employing either of the relay boxes described.

| Control Units for V300PT Series Pan and Tilt Drives | | | | | |
|---|---|---|---|---|---|
| Pan and Tilt Model | Control Model | Control Voltage | Relay Box | Wire Size (AWG) Annealed Copper | Maximum Distance (feet) |
| V300PT | V110PT (Pushbutton)<br>V111PT (Joystick) | 24 VAC 50/60 Hz | None | 20<br>18<br>16<br>14 | 250<br>400<br>650<br>1,000 |
| V300PT | V110PT (Pushbutton)<br>V111PT (Joystick) | 24 VAC 50/60 Hz | V180R | 22<br>20<br>18 | 6,000<br>10,000<br>15,000 |
| V300-115PT | V119PT (Pushbutton)<br>V120PT (Joystick) | 115 VAC 50/60 Hz | None | 20<br>18<br>16<br>14 | 1,600<br>2,500<br>4,000<br>6,400 |
| V300-115PT | V110PT (Pushbutton)<br>V111PT (Joystick) | 115 VAC 50/60 Hz | V183R | 22<br>20<br>18 | 6,000<br>10,000<br>15,000 |

NOTE: For long distance control with a simple twisted pair, the Vicon Modupulse™ Control System is recommended.

Table I Control Units for V300PT Series

M76

**WALL AND CEILING MOUNTS:** Many ceiling, pedestal and wall mounts are available which fit the V300PT units. Refer to Table II below:

| Mounts for V300PT Series | | |
|---|---|---|
| **VICON MODEL** | **TYPE OF MOUNT** | **CAPACITY, POUNDS** |
| V24WM | 24" Wall | 200 |
| V10CM | 10" Ceiling | 200 |
| V10PM | 10" Pedestal | 200 |
| V20CM | 20" Ceiling | 200 |
| V20PM | 20" Pedestal | 200 |
| V36CM | 36" Ceiling | 200 |
| V36PM | 36" Pedestal | 200 |

Table II Mounts for V300PT Series

**MODEL V503G WEATHERGUARD:** This accessory consists of a split metal shroud which prevents moisture from entering the unit. It should always be employed when the unit is mounted in an inverted position outdoors.

**CABLE GUARD:** The V501G Cable Guard should be ordered when it is necessary to prevent cable entanglement during combined pan and tilt action. This guard consists of a flexible nylon rod which is mounted on the pan and tilt drive counterbalance arms. Hardware is supplied.

## INSTALLATION

### Mounting the Unit

The V300PT is capable of operating with cameras weighing up to 35 pounds mounted vertically and 30 pounds when inverted. To perform properly, the unit must be securely fastened to a suitable mounting surface and the camera or enclosure must be properly mounted and balanced on the unit. The V300PT may be mounted directly to a surface capable of supporting the combined unit and camera weight or may be mounted with a Vicon wall- or ceiling-mount. When mounting directly to a wall or ceiling surface, use four 3/8" fasteners. When mounting with wall- or ceiling-mounts, use four 3/8" x 1" hex head bolts, lockwashers and nuts. The normal mounting position for the unit is with its axis vertical, either upright or inverted. The V300PT has been assembled at the factory for upright mounting.

**For inverted mounting, the V300PT should be prepared as follows:**

1. Insure that tilt drive is at center position and that the camera mounting surface is level.
2. Refer to Figure 2. Remove the three 10-32 screws (1) on camera mounting plate at end opposite the tilt-limit stop-plate.
3. Carefully pull end support (2) away from main housing, maintaining opposite end in postion.
4. Remove the two counterbalance springs (3) noting position of springs on grooved stop posts.
5. Replace end support (2) again holding opposite end in position.
6. Replace the three 10-32 screws (1).

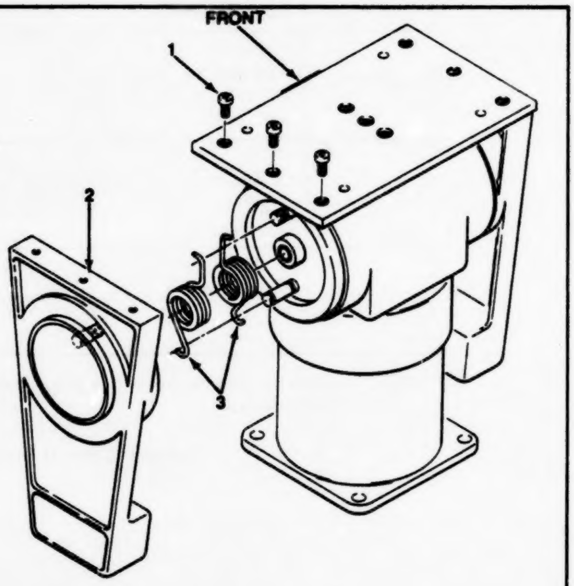


Figure 2 Removing Counterbalance Springs for Inverted Operation

If later it is necessary to replace the springs for upright operation, reverse the procedure, insuring that the springs are assembled as before. While mounting the pan and tilt drive, observe that maximum pan travel in either direction can be attained with the pan head rotated so that the side labeled FRONT faces opposite from the connector on the base casting. In this position the maximum pan travel is ±175 degrees if both pan limit stops are moved against the stop pin at the front of the unit.

NOTE: When unit is mounted in an inverted position, the left-right directions are reversed. Correct this when wiring the cable between the control unit and the pan and tilt drive. Simply reverse the leads going to terminals 5 and 6 (shown on Figures 4 and 5) of the connector at the control end of this cable.

CAUTION: When necessary to mount the pan and tilt drive outdoors in the inverted position, the V503G Weatherguard must be ordered and installed according to directions supplied with the kit. Failure to do so will void warranty.

## Mounting the Camera

Before mounting the camera to the pan and tilt drive, note the label FRONT on the top mounting plate. For upright installations the camera should be mounted with the lens on this side. For inverted mounting, face the camera in the opposite direction. A 1/4-20 captive screw (5 on Figure 3) has been supplied for mounting lighter cameras. This screw can be placed in any one of three positions to obtain optimum balance. When mounting heavier camera-lens loads, best operation is obtained when the load is evenly balanced. With the camera and lens resting on a flat surface, place a pencil under the camera and move the camera until it balances on the pencil. The position of the pencil under the camera indicates the point which should be positioned at the center of the pan and tilt mounting plate. The outboard mounting holes (6 on Figure 3) can be used to mount heavier cameras or enclosures. These holes also match the mounting holes in the Model V800H series Enclosures (refer to catalog sheet no. 151).

## Wiring the Unit to the System

Fabricate the interconnecting cable according to Figure 4 and 5 (when relay box V183R is used, see Figure 6). Units and controls are furnished with mating connectors.

## Adjusting the Limit Stops

After cable is assembled and unit connected, plug the control unit into a 115 VAC source and proceed as follows:

1. Loosen pan limit stops, (1 and 2 on Figure 3).
2. Push POWER switch on the control to energize unit, then rotate pan head using the joystick or manual RIGHT button until desired right pan limit is reached.
3. Locate the right pan limit stop (1 on Figure 3) and move until it contacts limit-switch actuator. Move the stop a slight distance further to deflect actuator until a "click" is heard indicating opening of limit switch. Lock the stop in place.
4. Rotate pan head to the desired left limit position. Adjust left pan limit stop (2 on Figure 3) in the same manner as the right pan limit stop.
5. With both limit stops in place, pan to both stop positions and recheck for exact trim of limit stops. Tighten both stops securely.
6. Looking at the front of the unit, remove the two screws (7 on Figure 3) from left end plate. Remove plate.
7. Loosen screws (3 and 4 on Figure 3) and rotate tilt drive to the desired up limit.
8. Move the up limit stop (3 on Figure 3) toward bottom end of slot until a click can be heard. Tighten screw.
9. Adjust the down limit stop (4 on Figure 3) the same way.
10. Lock limit stops securely in place and check for trim. Replace end plate.

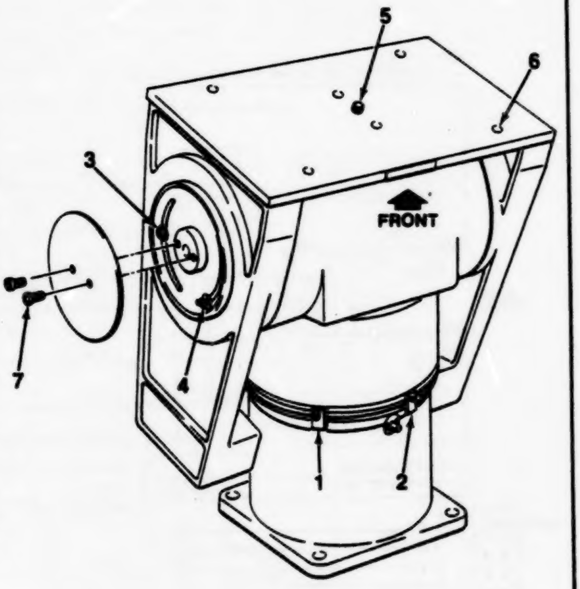


Figure 3 Pan and Tilt Limit Adjustments

## OPERATION

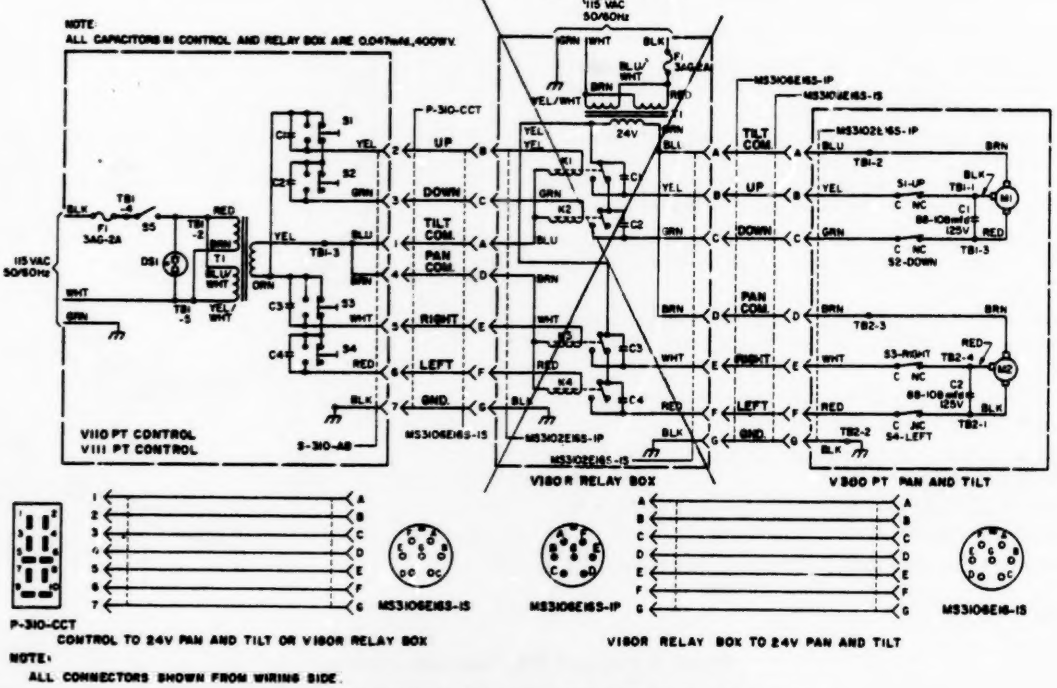
With a V300PT Series Pan and Tilt Drive wired to an appropriate control unit, movements along two axes are possible. "Pan" is the horizontal movement of the camera platform in either a right or a left direction. "Tilt" is a vertical movement of the camera platform in either an up or a down direction.

The V300PT is designed for remote control operation. With the appropriate control unit (and relay boxes, if required) installed and wired, the pan and tilt drive is ready to function.

1. Turn the control unit by pressing the main POWER switch. The red pilot light should illuminate.
2. To pan or tilt camera, operate switches for UP, DOWN, LEFT or RIGHT.
3. To drive two axes at once, one of the pan and one of the tilt direction switches may be operated at the same time. The joystick control, when deflected diagonally, will also drive pan and tilt functions simultaneously.

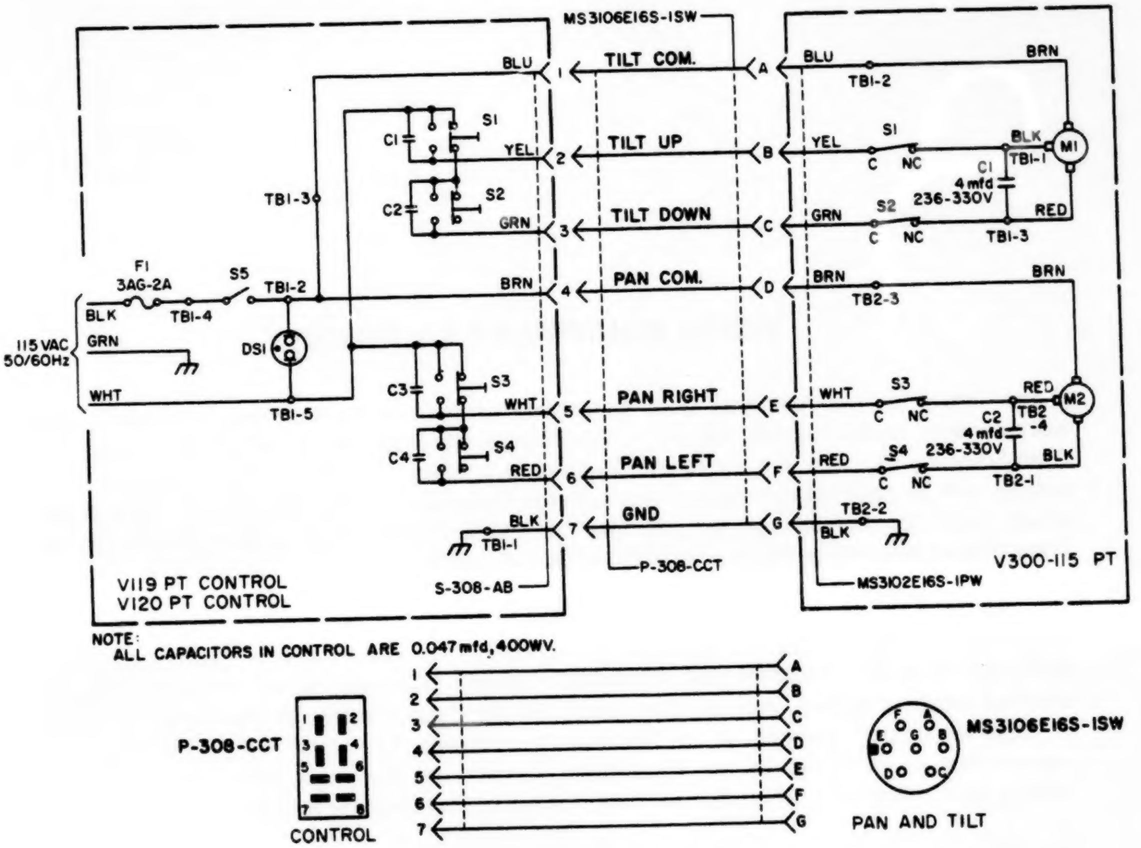
## SHIPPING INSTRUCTIONS

If a unit must be returned to the factory for any reason, package unit in original shipping carton or its equivalent for maximum protection.


NOTE
ALL CAPACITORS IN CONTROL AND RELAY BOX ARE 0.047mfd,400WV.
115 VAC 50/60Hz
F1 3AG-2A
S5
DS1
T1
TB1
S1
S2
S3
S4
C1
C2
C3
C4
YEL
GRN
BLU
BRN
WHT
RED
BLK
ORN
UP
DOWN
TILT COM.
PAN COM.
RIGHT
LEFT
GND.
P-310-CCT
S-310-AB
V110 PT CONTROL
V111 PT CONTROL
MS3106E16S-1S
MS3102E16S-1P
MS3106E16S-1P
K1
K2
K3
K4
24V
V180R RELAY BOX
S1-UP
S2-DOWN
S3-RIGHT
S4-LEFT
88-108mfd 125V
M1
M2
V300 PT PAN AND TILT
CONTROL TO 24V PAN AND TILT OR V180R RELAY BOX
V180R RELAY BOX TO 24V PAN AND TILT
NOTE:
ALL CONNECTORS SHOWN FROM WIRING SIDE.

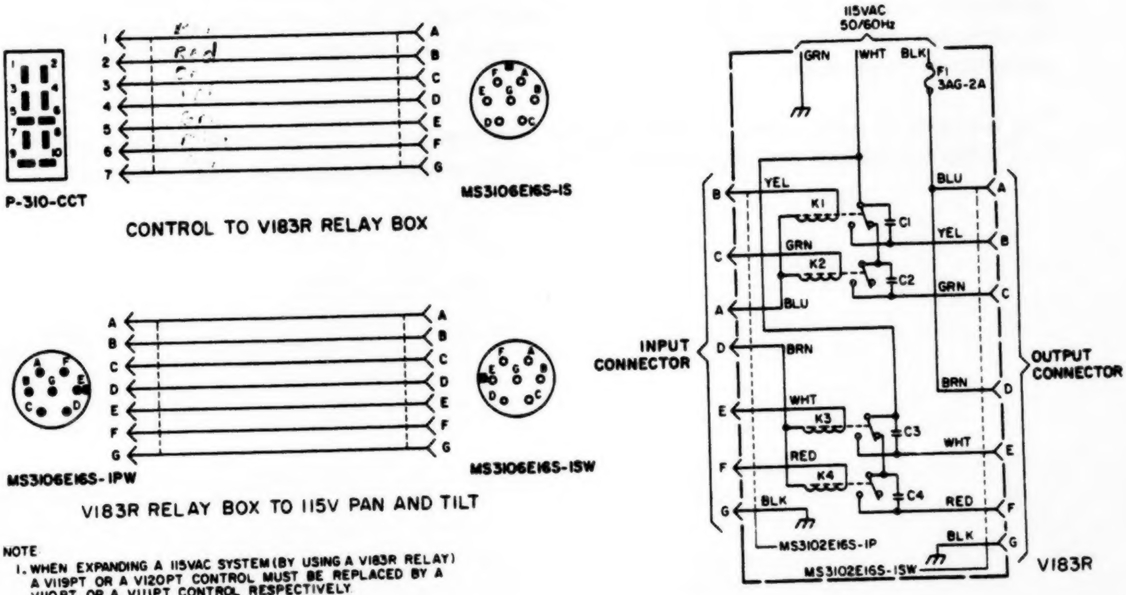
NOTE Relay box V180R. NOT fitted. G+M Pan and Tilt Control box fitted in lieu

Figure 4 Schematic Diagram, 24V (with Cable Assembly)


MS3106E16S-1SW
TILT COM.
TILT UP
TILT DOWN
PAN COM.
PAN RIGHT
PAN LEFT
GND
BLU
YEL
GRN
BRN
WHT
RED
BLK
S1
S2
S3
S4
S5
C1
C2
C3
C4
F1
3AG-2A
TB1-1
TB1-2
TB1-3
TB1-4
TB1-5
TB2-1
TB2-2
TB2-3
TB2-4
DS1
115 VAC
50/60Hz
M1
M2
C
NC
4 mfd
236-330V
V119 PT CONTROL
V120 PT CONTROL
S-308-AB
P-308-CCT
MS3102E16S-1PW
V300-115 PT
P-308-CCT
CONTROL
MS3106E16S-1SW
PAN AND TILT

NOTE:
ALL CAPACITORS IN CONTROL ARE 0.047mfd, 400WV.

Figure 5 Schematic Diagram, 115V (with Cable Assembly)


P-310-CCT
MS3106E16S-1S
CONTROL TO V183R RELAY BOX
MS3106E16S-1PW
MS3106E16S-1SW
V183R RELAY BOX TO 115V PAN AND TILT
115VAC
50/60Hz
GRN
WHT
BLK
F1
3AG-2A
YEL
BLU
BRN
RED
K1
K2
K3
K4
C1
C2
C3
C4
INPUT CONNECTOR
OUTPUT CONNECTOR
MS3102E16S-1P
MS3102E16S-1SW
V183R

NOTE
1. WHEN EXPANDING A 115VAC SYSTEM (BY USING A V183R RELAY) A V119PT OR A V120PT CONTROL MUST BE REPLACED BY A V110PT OR A V111PT CONTROL RESPECTIVELY.
2. ALL CONNECTORS SHOWN FROM WIRING SIDE.

Figure 6 Relay Box for 115V System (with Cable Assembly)

## VICON EQUIPMENT WARRANTY

Vicon Industries Inc. warrants your equipment to be free from defects in material and workmanship under normal use from the date of purchase for a period of 1 year (All Auto-Scanning Pan and Tilt Units and Medium and Heavy Duty Scanners, 6 months). Such defects will be repaired or replaced provided the equipment is returned prepaid. Service and adjustments for normal use will be made without charge within the warranty period. Thereafter repairs will be made at established factory prices.

This Warranty does not apply to equipment showing abuse or damage, or to parts which in the judgement of Vicon Industries Inc. are not defective, nor does it extend to any equipment which may have been tampered with, altered or repaired outside our factory. Your unit must be returned properly packed. Any damage caused, by accident in transit or elsewhere, by failure to observe proper packing or to observe instructions for installation, operation and maintenance as contained in the Instruction Manual furnished with each unit will not be covered by the Warranty. Shipment to Vicon Industries Inc. must be prepaid.

This Warranty is in lieu of all other Warranties expressed or implied, and no one is authorized to assume any liability on behalf of Vicon Industries Inc. or impose any obligation on it in connection with the sale of any equipment other than is outlined above. In no event will responsibility be assumed or implied for consequential damages arising from interrupted operation or other causes.

This Warranty is conditioned on and becomes effective ONLY IF THE PURCHASER FILLS OUT AND RETURNS THE REGISTRATION CARD within 14 days from date of purchase.

VICON® INDUSTRIES INC. 125 E. BETHPAGE RD., PLAINVIEW, N.Y. 11803 TEL. 516 293 2200

# SERVICE INSTRUCTIONS

## VICON V106AC-000-01 AND V107AC-000-01
## AUTO IRIS CONTROLS

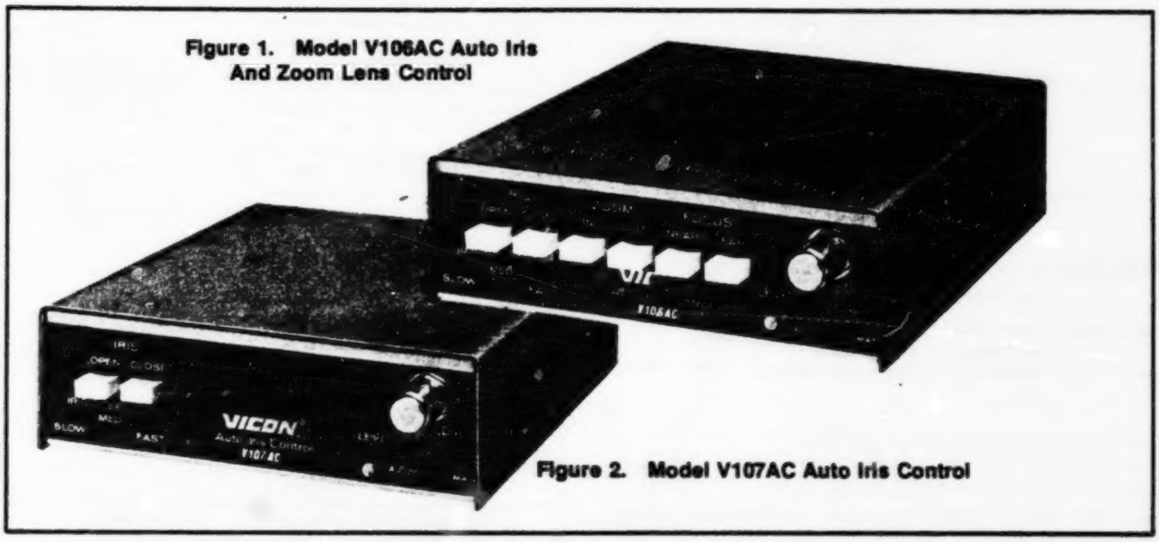


Figure 1. Model V106AC Auto Iris And Zoom Lens Control

Figure 2. Model V107AC Auto Iris Control

## INTRODUCTION

Vicon's V106AC or V107AC Auto Iris Control units figures 1 and 2 can be used to automatically or manually drive the iris servo of a TV camera lens. Each unit features a completely solid-state iris drive circuit that can automatically maintain constant video throughout the iris range. Average video amplitude can be adjusted by the operator as it appears on a TV monitor. Manual or automatic iris drive, auto iris response speed, and manual iris adjustment speed are provided by both units. When used with a sensitive camera and a proper lens, either unit will enable operation under lighting conditions from very bright sunlight to partial darkness.

The V106AC, in addition to iris control, enables pushbutton control of zoom and focus of the TV camera lens.

The V106AC operates with Vicon INTRASPOT$_{TM}$ Zoom lenses; V107AC with Vicon INTRASPOT$_{TM}$ fixed focal length lenses.

These controls will also operate Vicon standard zoom lenses or fixed focal length lenses equipped with iris limit switches (VSW option).

For Vicon INTRASPOT$_{TM}$ Motorized Zoom lenses or standard Motorized Zoom Lenses, a four-conductor, shielded cable is required. For INTRASPOT$_{TM}$ or standard Motorized fixed focal length lenses, a two-conductor shielded cable is required. Models V106AC and V107AC will operate a lens up to the following distances (with iris response set to MED or FAST):

| Wire Size, AWG | Distance, Ft. |
|---|---|
| 22 | 1000 |
| 20 | 1600 |
| 18 | 2300 |

INTRASPOT$_{TM}$ lenses incorporate a special graduated filter spot in the lens itself. As the iris closes, filter attenuation increases, thus allowing a camera to operate over an extremely wide light gradient, depending upon lens. There is no point at which a filter is rotated in or out of the optical path.

VSW option is specified when it is desired to use a standard Vicon motorized lens with Auto-Iris Control. This option is necessary with auto-iris operation in order to switch off the iris drive when lighting conditions are such that the iris is servo-driven to either the fully closed or fully open position. The VSW option incorporates internal limit switches to interrupt current flow to the iris motor when iris limits are reached. Switches are rated at 5 amperes, 10 million cycles. When ordering a Vicon motorized iris lens with this option add the suffix (–SW) to lens model number for example, V16-160M-SW.

DAYONITE$_{TM}$ option is specified when extension of night operation is especially desired. This option must be used with Vicon's DAYONITE$_{TM}$ lens. The Vicon DAYONITE$_{TM}$ motorized lens extends light transmission range to allow both day and night operation with modern sensitive video systems. A light attenuating (neutral density) filter is automatically inserted into the optical path when the motor driven iris closes to its highest f-number. The filter is then removed automatically when the iris reaches wide open position. This provides two ranges of f-stops. With the filter in place, only a small percentage of light is transmitted, allowing full daylight operation of the same camera that operates at full sensitivity under conditions of partial darkness.

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## MODELS V106AC AND V107AC SPECIFICATIONS

### OPERATIONAL

**Zoom:** In-Out Pushbuttons (V106AC only)
**Focus:** Near-Far Pushbuttons (V106AC only)
**Manual Iris:** Open-Close Pushbuttons
**Auto Iris:** Manual-Auto Slide Switch
**On-Off and Speed:** Knob Control
**Iris Response:** 3 position switch (Slow, Medium, Fast)
**Video Level:** Panel knob adjust
**Termination:** 75 ohm In-Out switch at rear
**Pilot Light:** Long Life LED indicator

### MECHANICAL

**Size (Desk Top):** **Height:** 2.06 inches
**Width:** 5.87 inches
**Depth:** 6.13 inches (Not including connector or front panel controls)
**Size (Racked):** ***Height:** 1.75 inches
**Width:** 19.00 inches
**Depth:** 5.75 inches (Behind panel, excluding connectors)
**Weight:** 4 pounds
**Construction:** Steel chassis and cover.
**Finish:** Black baked enamel chassis. Grey vinyl textured cover.

### ELECTRICAL

**Input Voltage:** 115 VAC 50/60 Hz (220 VAC Operation by rewiring power transformer)
**Power Consumption:** 3.6 Watts
**Output Voltage:** 2 to 8 volts DC
**Iris Control:** Direct coupled solid state
**Filter Drive optional (for Dayonite lenses only):** 5 volts DC
**Termination:** 75 ohms (optional with switch)
**Circuit Design:** Solid state throughout
**Line Cord:** Standard 3 conductor SV #18 AWG cable with grounded plug.
**Video Level:** 0.6-1.5 vp-p
**Output Connector:** Switchcraft 61HA5F (Mating connector Switchcraft 12CL5M supplied)
**Video Input Connector:** SO-239
**Video Output Connector:** SO-239
**Fuse:** 3AG ½ Ampere
**Lens Cable Requirements:** V106AC: DAYONITE$_{TM}$ Lenses: 5 conductor shielded. (Optional)
INTRASPOT or Vicon standard motorized lenses: 4 conductor shielded.
V107AC: 2 conductor shielded, 3 conductor shielded, Optional for DAYONITE$_{TM}$
**Video Cable:** Standard UHF

The unit operates up to the following distances from the lens:

| Wire Size (AWG) | Distance, Feet |
|---|---|
| 22 | 1000 |
| 20 | 1600 |
| 18 | 2300 |

---

*Units may be racked in single, double or triple versions.

## INSTALLATION

The V106AC and V107AC units sample and process the camera video signal to drive the iris until the video signal reaches an optimum value. The camera cable either may be looped through the unit or it may be terminated with 75 ohms at the unit as follows:

a. If the control unit is placed last in the video chain, the 75 ohm termination switch at rear of the chassis should be set to the IN position. The VIDEO OUT connector is not used.

b. If the control unit is a loop-through arrangement (not the last item in the video chain), the 75 ohm termination switch must be in the OUT position and the VIDEO OUT connector is used to connect to the next unit in the video chain such as monitor or video switcher.

Cabling diagrams for each type of control unit is shown in Fig 3.

Both units are designed to operate with standard video signals of levels from 0.6v p-p to 1.8v p-p. If trouble develops in a system containing a V106AC or V107AC, first ensure that cabling, camera, monitor, switching units or lens drive are not at fault.

CAUTION

The V106AC and V107AC are not recommended for lenses mounted on auto-pan systems due to constant wear on the lens mechanism as different light levels are encountered.

NOTE

Units are wired for 115 VAC operation. If 220 VAC operation is desired, refer to the schematic diagram, figure 5, for rewiring information.

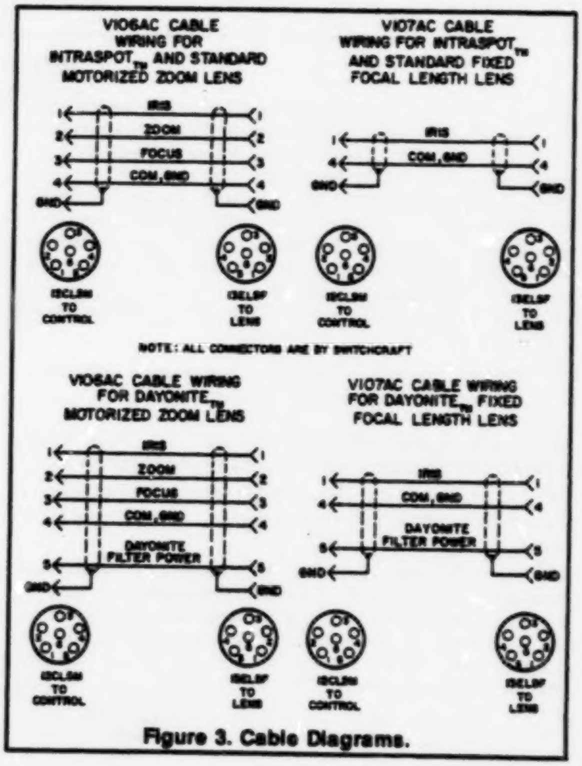

V106AC CABLE WIRING FOR INTRASPOT™ AND STANDARD MOTORIZED ZOOM LENS
IRIS
ZOOM
FOCUS
COM, GND
GND
12CL5M TO CONTROL
12ELSF TO LENS
V107AC CABLE WIRING FOR INTRASPOT™ AND STANDARD FIXED FOCAL LENGTH LENS
IRIS
COM, GND
GND
12CL5M TO CONTROL
12ELSF TO LENS
NOTE: ALL CONNECTORS ARE BY SWITCHCRAFT
V106AC CABLE WIRING FOR DAYONITE™ MOTORIZED ZOOM LENS
IRIS
ZOOM
FOCUS
COM, GND
DAYONITE FILTER POWER
GND
12CL5M TO CONTROL
12ELSF TO LENS
V107AC CABLE WIRING FOR DAYONITE™ FIXED FOCAL LENGTH LENS
IRIS
COM, GND
DAYONITE FILTER POWER
GND
12CL5M TO CONTROL
12ELSF TO LENS

Figure 3. Cable Diagrams.

M84

## OPERATION

V106AC and V107AC operating controls and indicators (figure 4) with their functions are provided in the following list:

| | |
|---|---|
| **Red Power Lamp:** | Lights when unit is energized. |
| **IRIS pushbuttons:** | OPEN and CLOSE pushbuttons enable manual iris operation when AUTO-MAN switch is in MAN position. In manual mode when OPEN pushbutton is depressed, lens iris closes. |
| **IRIS RESPONSE slide switch (SLOW-MED-FAST):** | Determines the time required for iris to automatically respond to changes in light level in AUTO mode of AUTO-MAN switch. SLOW setting results in least wear to lens mechanism. |

CAUTION

The V106AC and V107AC are not recommended for lenses mounted on auto-pan systems due to constant wear on the lens mechanism as different light levels are encountered. If, however, the control is used with auto-pan units, IRIS RESPONSE should be set to SLOW.

| | |
|---|---|
| **SPEED control and on-off power switch:** | Determines time required for all normal functions to respond, such as: IRIS, ZOOM (V106AC only) and FOCUS (V106AC only) in MAN mode of AUTO-MAN switch. Also, on and off power switch. |
| **LEVEL control:** | Sets average video level in AUTO mode of AUTO-MAN switch. |
| **AUTO-MAN switch:** | Selects automatic or manual mode of IRIS operation. |
| **ZOOM pushbuttons (V106AC only):** | Depressing IN pushbutton causes zoom lens to enlarge on object; OUT to broaden view of scene. |
| **FOCUS pushbuttons (V106AC only):** | Depressing NEAR or FAR adjusts lens for focus as viewed on monitor by operator. |
| **75 ohm IN-OUT switch (on rear panel):** | Connects 75-ohm load across VIDEO IN and VIDEO OUT connectors for impedance matching. |

An operational check of the V106AC and V107AC units are provided in the following paragraphs:

Connect the Cables after first making sure that monitor, camera, and other elements of the system are operating properly. Then proceed as follows:

1. Energize the video system. The unit is plugged into a 115 VAC 50/60 Hz. source (220 VAC 50/60 Hz. operation is possible by rewiring power transformer; refer to figure 4).
2. Turn unit on by rotating the SPEED control clockwise. Set SPEED control about ¼ turn from the off position. Set the AUTO-MAN switch to MAN.
3. Obtain an acceptable picture on TV monitor by manual adjustment of the iris.
4. For V106AC operation only, operate the FOCUS and ZOOM controls determine if these functions of the system are operating by observing TV monitor.
5. Set the IRIS RESPONSE switch to FAST.
6. Switch to AUTO and adjust the LEVEL control for an optimum video level.
7. Switch to MAN and run the iris fully closed. Then switch to AUTO and note the video returns to that obtained in step 6.
8. Switch to MAN and run the iris to the fully open position. Then switch to AUTO and note that video returns to that obtained in step 6.

NOTE

Some sensitive low light level cameras should not be exposed to bright light with iris fully open. Step 8 should be conducted in subdued lighting or the lens shielded during this step.

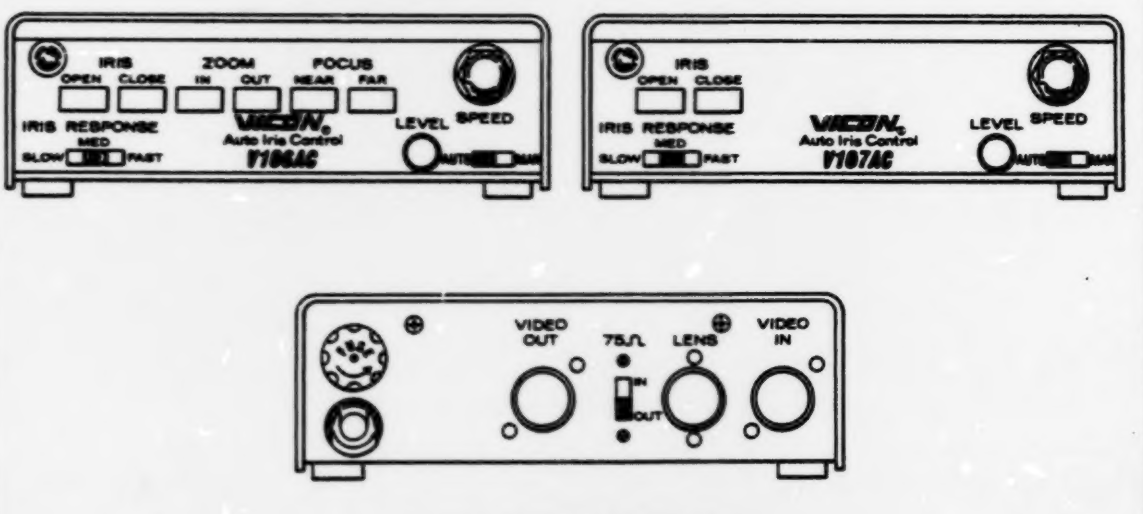


Figure 4. Controls And Indicators.

## PRINCIPLES OF OPERATION

To enable understanding of the following discussion, refer to the schematic diagram, figure 5. All descriptions refer to both the V106AC and V107AC models with the exception of ZOOM and FOCUS functions, which apply only to the V106AC model.

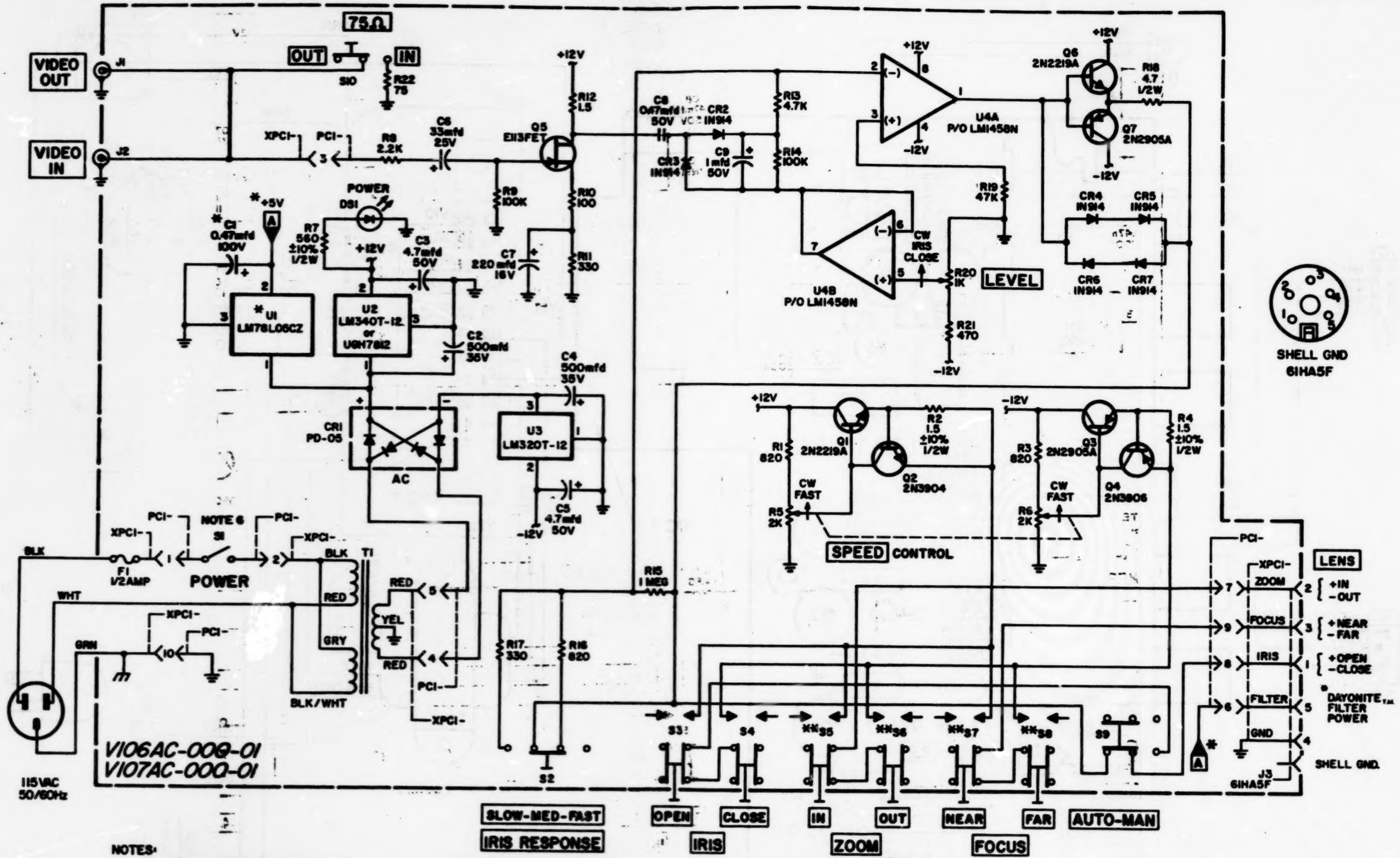
The two modes of operation of the control unit are: MAN and AUTO, as selected by setting switch S9.

In the MAN mode, d-c voltages are applied to switches S3 through S8 from the control circuits formed by Q1 through Q4. Any output can withstand continuous short circuits to ground without causing semi-conductor failure. Transistor Q1 is an emitter follower circuit and provides a positive voltage, the level of which is determined by variable resistor R5. In a like manner, transistor Q3 provides a negative voltage; the level is set by resistor R6. Q2 and Q4 are current limiter transistors. When switches S3 (IRIS OPEN), S5 (ZOOM IN), and S7 (FOCUS NEAR) are depressed, positive voltages are applied to pins 1, 2, and 3 respectively of the LENS connector. This opens the iris, zooms in the lens, and adjusts the lens for nearer viewing. When switches S4 (IRIS CLOSE), S6 (ZOOM OUT), and S8 (FOCUS FAR) are depressed, a negative voltage is applied to pins 1, 2, and 3; this causes an opposite reaction of the IRIS, ZOOM and FOCUS functions. The switches are interwired so that only one polarity can be applied at a time. Thus, if a ZOOM IN and OUT are depressed together, IN would take precedence and OUT will be disconnected. Likewise, IRIS OPEN takes precedence over CLOSE, and FOCUS NEAR takes over FAR. The SPEED control (R5 and R6 ganged variable resistors) sets the voltages fed to the manual switches S3 through S8, thus determining the speed at which the functions respond.

In the AUTO mode, the power from switches S3 and S4 (IRIS OPEN and IRIS CLOSE) are disconnected from the LENS connector. Switches S5 through S8 are not affected. Iris drive power is received from the automatic iris circuit formed by transistors Q5 through Q7 and intergrated circuits U4A and U4B. Video signals from the TV system are amplified by Q5 and then rectified by the CR2 and CR3 circuit. This d-c signal is compared against a d-c reference voltage from U4A, and applied to a complimentary symetrical emitter follower pair Q6 and Q7. A negative or positive voltage is produced by this stage and applied to the LENS connector via switch S9. The polarity of this signal is determined by the amplitude of the rectified video compared to the reference signal from U4B. If the video signal is larger than the reference signal, the resultant LENS polarity voltage will be negative; if smaller, the polarity will be positive. A negative voltage closes the iris. Equilibrium is reached when the rectified video equals the reference voltage. Adjustment of the LEVEL control R20 sets the reference voltage and thus sets the iris of the lens. Diodes CR4 through CR7 form a current limiting stage that prevents overdriving the iris motor. Switch S2 IRIS RESPONSE is used to select the degenerative feedback paths (provided by resistors R15 through R17) around the iris drive circuits, thus controlling the response time. A full wave bridge rectifier, CR1, provides both positive and negative d-c voltages. Intergrated circuits U2 and U3 regulate these voltages. Intergrated circuit U1 is provided when DAYONITE option is ordered; U1 regulates DAYONITE power.

## MAINTENANCE

The V106AC and V107AC units are completely solid-state. They are designed for years of service without requiring maintenance. An understanding of the PRINCIPLES OF OPERATION should aid in localizing a unit fault. If trouble develops in a system containing a V106AC or V107AC, first ensure that cabling, camera, monitor, switching units, or lens drive are not at fault. This can sometimes be determined by interchanging cables or, if possible, substituting units.


VIDEO OUT
J1
75Ω
OUT
IN
S10
R22 75
VIDEO IN
J2
XPC1-
PC1-
3
R8 2.2K
C6 33mfd 25V
R9 100K
Q5 E113FET
+12V
R12 1.5
R10 100
R11 330
C7 220 mfd 16V
C8 0.47mfd 50V
CR2 IN914
CR3 IN914
C9 1 mfd 50V
R13 4.7K
R14 100K
+12V
U4A P/O LM1458N
-12V
R19 47K
U4B P/O LM1458N
CW IRIS CLOSE
R20 1K
LEVEL
R21 470
-12V
+12V
Q6 2N2219A
R18 4.7 1/2W
Q7 2N2905A
-12V
CR4 IN914
CR5 IN914
CR6 IN914
CR7 IN914
SHELL GND
61HA5F
*+5V
A
*C1 0.47mfd 100V
POWER
DS1
R7 560 ±10% 1/2W
+12V
C3 4.7mfd 50V
*U1 LM78L05CZ
U2 LM340T-12 or UGH7812
C2 500mfd 35V
C4 500mfd 35V
CR1 PD-05
AC
U3 LM320T-12
C5 4.7mfd 50V
-12V
+12V
R1 820
Q1 2N2219A
R2 1.5 ±10% 1/2W
Q2 2N3904
CW FAST
R5 2K
-12V
R3 820
Q3 2N2905A
R4 1.5 ±10% 1/2W
Q4 2N3906
CW FAST
R6 2K
SPEED CONTROL
BLK
WHT
GRN
XPC1-
PC1-
NOTE 6
S1
F1 1/2AMP
POWER
T1
BLK
RED
RED
YEL
GRY
RED
BLK/WHT
PC1-
XPC1-
R15 1 MEG
R17 330
R16 820
S2
S3
S4
**S5
**S6
**S7
**S8
S9
LENS
ZOOM
FOCUS
IRIS
FILTER
GND
+IN -OUT
+NEAR -FAR
+OPEN -CLOSE
*DAYONITE TM FILTER POWER
SHELL GND.
J3 61HA5F
115VAC 50/60Hz
V106AC-000-01
V107AC-000-01
SLOW-MED-FAST
IRIS RESPONSE
OPEN
CLOSE
IRIS
IN
OUT
ZOOM
NEAR
FAR
FOCUS
AUTO-MAN

NOTES:

1. UNLESS OTHERWISE INDICATED, ALL RESISTORS ARE IN OHMS, ±5PERCENT 1/4WATT.
2. FUNCTION NAMES IN BOXES DENOTE PANEL MARKINGS.
3. * INDICATES OPTIONAL DAYONITE TM FILTER POWER.
4. ** INDICATES SWITCHES S5 THRU S8 ARE NOT INCLUDED IN MODEL V107AC.
5. FOR 220VAC INPUT, CONNECT T1 AS SHOWN IN DETAIL A. REPLACE 1/2 AMP FUSE WITH 1/4 AMP FUSE.
6. SWITCH S1, PART OF SPEED CONTROL.

DETAIL A - TRANSFORMER T1 CONNECTED FOR 220 VAC

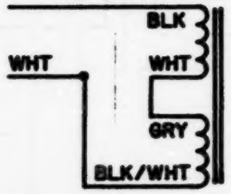

BLK
WHT
WHT
GRY
BLK/WHT

Figure 5. V106AC And V107AC Schematic Diagram

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CA1
DTC 801
81
M81I
V.2
c.2

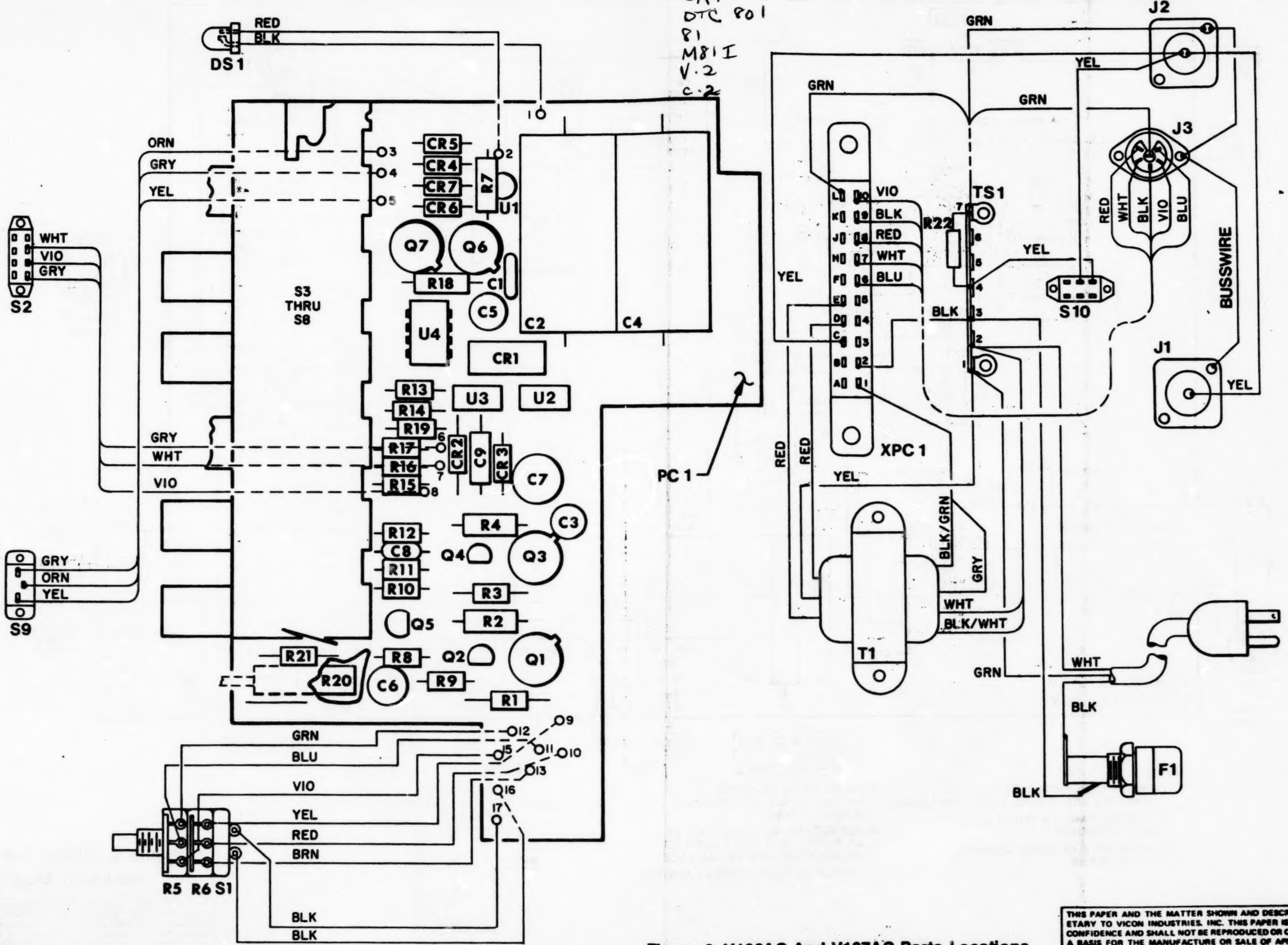
RED
BLK
DS1
ORN
GRY
YEL
WHT
VIO
GRY
S2
1
2
3
4
5
CR5
CR4
CR7
CR6
R7
U1
Q7
Q6
R18
C1
C5
U4
S3
THRU
S8
C2
C4
CR1
R13
R14
R19
U3
U2
GRY
WHT
VIO
R17
R16
R15
6
7
8
CR2
C9
CR3
C7
R12
C8
R11
R10
R4
C3
Q4
Q3
R3
GRY
ORN
YEL
S9
Q5
R2
R21
R20
R8
Q2
Q1
C6
R9
R1
9
12
11
10
15
13
16
17
GRN
BLU
VIO
YEL
RED
BRN
BLK
BLK
R5
R6
S1
PC 1
GRN
J2
YEL
GRN
GRN
J3
VIO
BLK
RED
WHT
BLU
TS1
7
6
5
4
3
2
1
R22
YEL
YEL
BLK
S10
RED
WHT
BLK
VIO
BLU
BUSSWIRE
J1
YEL
L
K
J
H
F
E
D
C
B
A
10
9
8
7
6
5
4
3
2
1
XPC 1
RED
RED
YEL
BLK/GRN
GRY
WHT
BLK/WHT
T1
GRN
WHT
BLK
BLK
F1

Figure 6. V106AC And V107AC Parts Locations.

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